HANDBOOK FOR BETTER EDIBLE BEAN PRODUCTION

2018

Minnesota — North Dakota

ADM

ADM Edible Bean Specialties, Inc.

"The Bean People"

Seedwest®

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For further dry bean resources see page 75

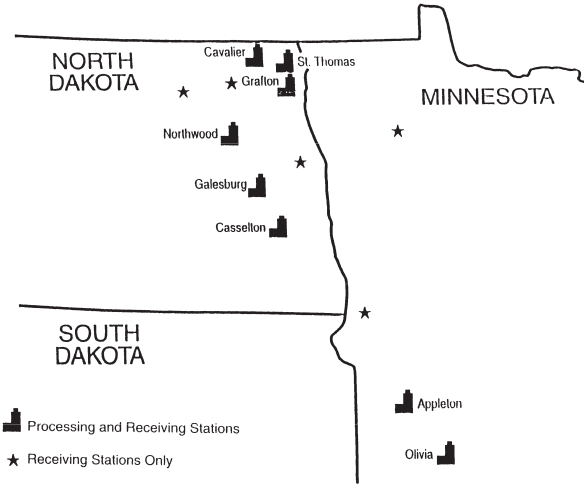
Cover photo:
Another season's promise - Olivia, MN

This booklet is intended for use in Minnesota – North Dakota only.

See full disclaimer on page 76

ADM

“The Bean People”



SUGGESTED BEAN PRODUCTION GUIDELINES

ADM EDIBLE BEAN SPECIALTIES

May: Adopt a complete weed control program - cultural as well as chemical.

Apply preplant or preplant incorporated herbicide, incorporated twice.

Fertilize. Pay particular attention to N, P, K, and zinc.

Plant Shallow (1 1/2 to 2 inches) in a warm, firm seed bed.

Return unopened seed bags to ADM by June 1.

June: Notify ADM as to changes on field descriptions for new crop contracts if necessary.

Rotary hoe - control weeds while still in the "white stage."

Cultivate. Avoid pruning roots during second cultivation.

Spray for broadleaf weeds if need be. Know your weeds, apply the correct herbicide!

Foliar apply zinc chelate if beans appear stunted or yellow.

Maintain production records: See pages 98 & 99

July: Maintain complete weed control. Consider hand labor if necessary. Weeds at harvest time cause problems.

Avoid walking in fields while foliage is wet.

Consider spraying for white mold at 100% bloom. Ample moisture and lush growth may warrant spraying. Timing and method of application determine the level of control when spraying for this disease.

Monitor bean fields for rust. Spray if detected and beans haven't begun striping or turning buckskin.

August: Continue fungicide applications if rust is severe.

Apply last irrigation water at mid-month.

Install slow down kit in combine.

September:

HARVEST WHEN CONDITIONS WARRANT – DO NOT DELAY!

Navy Beans 18% moisture
Pinto Beans 16% moisture
Black Beans 16% moisture
Foliage and soil sufficiently dry
Weather is suitable

Avoid leaving cut fields for extended periods. Ideally cut and harvest the same day.

Properly set combine: Cylinder speed 150 to 300 rpm. Concave clearance as great as possible while still doing an adequate job.

DO NOT CONTAMINATE EDIBLE BEANS WITH SOYBEANS OR CORN! Severe penalties exist.

Order seed for coming year.
Early orders assure the varieties you desire.

WELCOME TO THE WONDERFUL WORLD OF EDIBLE BEANS

When edible beans were introduced into the Minnesota-Dakota market in the early 1960s, very few farmers had even heard of edible beans. Today, farmers throughout this vast production area talk edible beans much like they talk any other crop. They now know the crop, they understand the special management in growing and harvesting edible beans, and they relish the economic advantage edible beans offer their total farming program.

Edible beans have now become big business to our Minnesota-Dakota growers. Farmers think big and farm big in the prairie-rich country. They handle edible beans in the same style- 160 acre fields are prevalent, even half section and larger fields have become commonplace. This means well financed growers with absolutely the best in farm machinery striving towards the most efficient management. And when you're dealing with the best kind of growers, it's our experience you get the best quality beans.

Minnesota-Dakota prairie country has a near perfect environment for edible bean production. Rich fertile soils, adequate moisture, and progressive growers have resulted in our Northarvest area becoming the largest edible bean production area in North America. Economic advantages of our Minnesota-Dakota production areas are obvious: (1) Higher average yield per acre, (2) Higher net return per acre, (3) Less disease problems, (4) A better quality bean. The end result: satisfied growers, satisfied end users, and satisfied customers.

We thank you, the Minnesota-Dakota farmer, for putting edible beans into your farming program. And for making ADM Edible Bean Specialties, Inc. Number 1…in navy, pinto, and black beans. We appreciate YOU!!!

ADM Edible Bean Specialties, Inc.

PRODUCTION GUIDE FOR EDIBLE BEANS

INDEX

NEW FOR 2018

Seed to be sold by units:
In response to grower requests, beginning in 2016 ADM Seedwest began shipping seed packaged and priced by the unit rather than by the pound; we have now moved to a true unit system. Striving to maintain the highest quality dry bean seed in the industry while concurrently addressing grower concerns, a unit will now consist of 100,000 seeds, regardless of class. Beginning in 2017, a tote - depending on class and variety - contains a consistent number of units, while the weight will vary. Bags for the present will remain 50 pounds. See further information on page 39.

Volunteer soybeans and their control: With the advent of glyphosate resistant crops, volunteer soybeans have become common, persisting for several seasons and often regenerating in dry beans. *If not controlled these plants will again reproduce and result in financial penalties or total rejection of the dry bean crop.* For the past five seasons growers have experimented with **POST** applications of Permit herbicide (Gowan) with very satisfactory results, often leading to total elimination of the soy plants. Apply at .67 oz. DF per acre pre-flowering. Continue to monitor fields for escapes. Rotational restrictions apply, particularly sugarbeets, potatoes, sunflowers and canola. Follow label instructions and consult your ADM agronomist for further discussion.

White Mold Control: Year in and year out growers list white mold (Sclerotinia sclerotiorum) as one of the most challenging aspects of dry bean production; the disease can seemingly reduce yields by 30% or more over-night. While traditional fungicides are available and effective, total control is seldom achieved, and in 2017 regional growers began experimenting with application of hydrogen peroxide and hydrogen dioxide. Interestingly, kidney bean growers in

Central Minnesota have used the product in the past with varying degrees of success. Talk to your ADM agronomist concerning this new and not-traditional tool to control an old and familiar disease.

Improved Seed Treatment: Addressing concerns over increased incidence of root rots, ADM Seedwest will continue treating all seed with a unique blend of seed protectants, specifically tailored to provide activity on common soil-borne fungi such as *Rhizoctonia* and *Fusarium* spp. This will be standard treatment on all seed at no extra cost; for growers seeking even higher levels of protection various options are available as well. Please contact your ADM agronomist for further information.

Anthracnose: Several east-central North Dakota counties experienced alarmingly high levels of anthracnose in 2011 and 2014. For a more in-depth look at anthracnose and its potential negative impact on dry bean production see page 10.

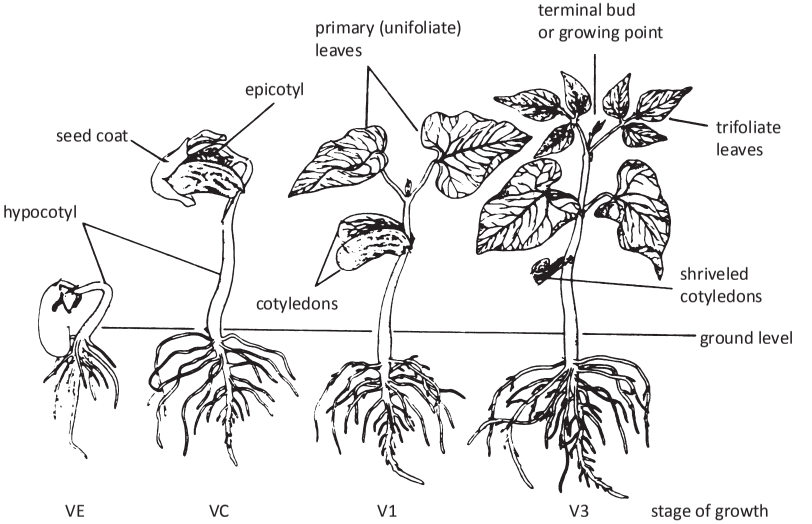
Rust: A new and highly virulent strain of bean rust *(Uromyces appendiculatus)* was identified in Traill County, North Dakota in 2008. It has been determined that this new strain is capable of overcoming Ur3, the most common gene for rust resistance found in prevalent Mn-Dak varieties. In 2009, rust was of little significance in Mn-Dak; in 2017 and 2011 pockets of rust infested both navy and pinto fields, the extent being limited by warm and dryer conditions. Growers are urged to monitor fields in 2018, and stay in close contact with their ADM agronomist. Additionally, updates will be posted through the ADM electronic updates.

Desiccant Quick Sheet: Many growers consider desiccation an essential part of a successful harvest. For a quick reference on labeled compounds and rates see page 68.

Herbicide update for 2018: Page 33

Insecticide update for 2018: Page 47

Fungicide update for 2018: Page 61



Early growth of a dry bean seedling, with growth stage designations

HISTORY OF BEAN CULTURE

The common bean *(Phaseolus vulgaris)* was domesticated from a wild form which was found in Mexico and Central America. It is now known that edible beans were being cultivated in Callejon de Huaylas, Peru and in the Tehuacan Valley in Mexico 7000 years ago. Seed was collected by early explorers of the New World and was being grown in Europe by 1542. They have since spread to every corner of the earth, and become an important human food of high protein and complex carbohydrate content. Today beans are grown on nearly 57 million acres world-wide.

AGRONOMIC NOTE

When growing edible beans, it is of utmost importance to pay close attention to basic practices before actual planting. Proper site selection, following adequate rotations, selecting the correct variety for your geographic area, buying high quality seed, proper fertility, and an adequate weed control program will prevent many problems from ever occurring in the field.

SOIL SELECTION

1. Well-drained soils with good water holding ability are preferred.

2. Uniformity (avoid slow growth areas).

3. Soil test to determine pH and fertility needs. If pH is above 7.0, test for possible zinc deficiency.

4. Avoid high alkaline areas.

5. Avoid soils high in soluble salts. This can be detected through a soil test.

CROP ROTATION

1. Edible beans may follow or succeed many crops. However, diseases may result from following other edible beans, sugarbeets, sunflowers, snapbeans, mustard and canola.
2. It is recommended that you have at least a three year crop rotation.

SEEDBED PREPARATION

1. Avoid overworking soil because of compaction.
2. Prepare a level seed bed. This will make planting and harvesting easier.
3. Plant the same way the field was plowed – you will find harvesting easier.

BEAN ANTHRACNOSE ALERT!!

Bean anthracnose – a seed-borne fungal disease more often associated with Michigan dry bean acreage – was detected in numerous Mn-Dak bean fields in 2006 and subsequent years including 2015. Caused by the fungus *Colletotrichum lindemuthianum*, dry beans are essentially the only host of this disease, and the primary source of infection is infected seed. Often starting with only a few infected seeds, anthracnose spreads when conditions are favorable: mild temperatures and frequent rains. With a life cycle of only 7 to 14 days, infections quickly spread throughout the entire field as well as neighboring bean fields. All above ground parts of the plant are affected, including the seed. While yield is severely reduced, it is the quality of the bean itself that becomes the larger issue: Black fungal growths on the seed result in heavy financial discounts or total rejection by the canner.

Clearly, anthracnose is a disease to be avoided at all costs. The best protection a bean producer has – no questions asked – is the use of high quality, western-grown anthracnose free seed. Once detected in the field, control is both *very* expensive and *very* difficult if not impossible. **Don't risk it: Demand western-grown seed in 2018, and encourage your neighbor to do the same. Our dry bean industry depends on it!**

Do <u>not</u> plant bin run seed, it is the primary source of anthracnose!

BREEDER'S CORNER 2018

Why do beans that are an off-type or different market class unexpectedly show up in fields or the harvested crop? Off-type beans can be a challenge throughout the entire bean supply chain from the breeder to the consumer. It takes a lot of conscientious, focused work for the seed industry to keep market classes and varieties separate. Many growers plant and harvest multiple varieties and multiple market classes. It only takes a few seeds stuck inside a piece of machinery or inadvertently moved between fields or seed lots to cause contamination. If the beans are close in shape or size then it may be nearly impossible to separate the contaminants from the desired beans. Thus one cause of contamination is simply mixing of two different classes or varieties of beans.

Another cause of contamination is genetic change in the variety caused by crossing or mutation. Breeders intentionally make crosses between varieties and market classes to move genes and thus traits from breeding lines into new varieties. It takes several generations of self-pollination and selection to produce a pure, homozygous variety. There could still be a small level of heterozygosity in a pure line many generations out from a cross. The genetic impurity and the issues it could create would depend on the particular genes that are different between the parents, where those genes are on the chromosome, and the breeding and

selection methods used by the breeder. Outcrosses can occur naturally even though the bean flower does not normally lend itself to cross-pollination. Insects may be capable of moving pollen between bean flowers and thus cause cross-pollination. Natural mutations inside a plant could also cause changes in the genetics of bean plants. The environment in which a plant is grown also has a significant impact on the expression of genes and thus can have an effect on whether certain traits are seen.

There are a number of genes involved in bean color and color patterns. The specific number of genes depends on the color and pattern specific to each market class. Some of the genes also depend on the presence or absence of signals from other genes in order to work. These factors add to the genetic complexity of the trait. One of the simplest gene interactions was illustrated in a research article in the Crop Science journal in 2017[1]. In the article, the researchers described crossing a black bean with a white (Navy) bean "for the purpose of understanding the genetic basis of seed coat color", and "to identify novel gene loci and alleles for seed coat color." The seeds from the cross were self-pollinated after the cross was made. The first generation after the cross produced all black beans. This was consistent with the expectation that the black seed color is dominant over the white seed color and also with the use of the black parent as the maternal parent and thus the producer of the seed coat tissue. The next two generations resulted in 3 color classes, black, gray and white. The ratio of the classes was close to 12 black, 3 gray, and 1 white. This indicates that it is likely that 2 genes dominant for the black color affected the coloration of the progeny. In the article the researchers proposed that the black bean parent contributed dominant alleles AABB. The white bean parent contributes aabb. Assuming that x could be alleles, A or a, or B or b, progeny with the alleles Axxx are black. Progeny with the alleles aaBx are gray. The white beans continue to carry the recessive alleles aabb. This research illustrates that it is very possible for an outcross to produce all black beans in the first generation and then give rise to black, white and gray beans in successive generations. The dominant black color masks the beans carrying the recessive genes for the white color. White and gray colored beans then occur in subsequent generations after self-

pollination takes place because some of the progeny carry some or all of the recessive genes. Similar situations could arise with different parents and different kinds of beans.

The author believes that the research described in the article is simply a good illustration of the genetics involved in seed coat coloration of the specific black and white lines used. It does not universally apply to all crosses involving black and navy beans. Crosses involving other parents often yield different results as far as the ratio of colored to white beans. For example, the author will often not see gray beans in crosses between black and white parents. More often there are only black and white beans. Sometimes brown, purple, or other off-type beans appear. However the general rule is that black is dominant to white.

Pure line selection takes place by growing either single seeds or progeny of single plants for 2 or more generations. If the progeny is uniform and true to expected seed type for multiple generations, then the line is pure and can be used to grow seed.

For more information, see the reference below. It is an open access article so the cost to read is free. There is also a listing of related research articles at the end.

1\ "Novel Alleles for Black and Gray Seed Color Genes in Common Bean", J. Zhu, J. Wu, L. Wang, M.W. Blair, and S. Wang; Crop Sci. 57:1603-1610 (2017) doi:10.2135/cropsci2016.05.0356

Brett Despain
Research Manager, ADM Seedwest

SEED & VARIETIES

1. Western grown seed should be used to help reduce the risk of seed-borne diseases. Using bin-run or locally produced seed has been shown to significantly increase the introduction of various diseases to a field, including bacterial blight or anthracnose, with no effective options for control. Profitability is dependent upon two factors: yield and bean quality. High quality, disease free seed provides the foundation for successful dry bean production.

2. Seed treatment including fungicides for soil-borne fungi for early protection, is strongly recommended**. ADM Seedwest dry bean seed is western grown, treated with a unique blend of several fungicides highly effective for Mn-Dak soils, and is ready for planting.** Our heavy wet soils, especially during spring planting, frequently cause undue stress. **Demand the best, plant Seedwest!**

3. Cruiser (thiamethoxam) is a labeled seed treatment available upon request. Cruiser provides a wide range of early season control of sucking and leaf-chewing insects. Cruiser will provide 30 to 40 days of control of potato leafhoppers, often eliminating the need to spray, or reducing the number of post-applications. Talk to your ADM agronomist for further information and recommendations.

4. Inoculation at planting time may or may not be beneficial. These beans are a legume and the strain of bacteria necessary for nitrogen fixation may be lacking in the soil.

5. HANDLE SEED CAREFULLY – DO NOT DROP THE BAGS. Rough or unnecessary handling can damage the growing point within the seed, resulting in a poor stand.

RECOMMENDED VARIETIES 2018

VARIETY	STRUCTURE	RELATIVE MATURITY
Navy		
HMS Medalist	Upright short-vine	103 Day
Blizzard (08072)	Upright short-vine	103 Day
T9905	Upright short-vine	103 Day
Indi	Upright short-vine	102 Day
Vigilant	Upright short-vine	102 Day
Ensign	Bush short-vine	102 Day
Pinto		
Monterrey	Upright short-vine	104 Day
Vibrant*	Upright short-vine	102 Day
Radiant*	Upright short-vine	102 Day
Cowboy (11278)	Upright short-vine	102 Day
La Paz	Upright short-vine	104 Day
Santa Cruz	Upright short-vine	104 Day
Torreon (06206)	Upright short-vine	103 Day
Sinaloa	Upright short-vine	102 Day
Windbreaker	Bush short-vine	102 Day
Black		
Eclipse	Upright short-vine	99 Day
Black Cat (06252)	Upright short-vine	101 Day
Black Bear	Upright short-vine	103 Day
Loreto	Upright short-vine	101 Day
Shania	Upright shot-vine	102 Day
Zorro	Upright short-vine	103 Day
Zenith	Upright short-vine	105 Day

* slow darkening

Further varietal descriptions on page 17

VARIETY DESCRIPTION

Navy

Ensign: Mid to full-season maturity. Bush short-vine. Tested as ROG 372. "I" gene resistance to BCMV. Owned and distributed by ADM Seedwest.

Indi: Tested as N5027557. Upright short-vine. Navigator type. Excellent dry-down Possible drought tolerance. "I" gene BCMV resistance. Well suited for direct harvest. Owned and distributed by ADM Seedwest.

Alpena: Developed by MSU Ag Bio Research. Released 2014. Upright mid to full-season. Developed for northern production regions. Upright structure may avoid white mold. Tested as N11283.

T9905: Full-season. Upright short-vine. BCMV strain 1 & 15 resistance. Developed by Hyland Seeds.

HMS Medalist: Tested as 01054. Mid to full-season. Upright short-vine. "I" gene resistance to BCMV. AmeriSeed. Developed by ProVita Owned and distributed by ADM Seedwest.

Blizzard Upright short-vine. Tested as 08072. Structure and maturity similar to Medalist but with possible higher pod set. Developed by ProVita Distributed by AmeriSeed through ADM Seedwest.

Vigilant: Tested as 02084. Upright short-vine. Medalist maturity minus 1 - 2 days. Good potential for direct harvest. Developed by ProVita, Inc. in conjunction with Cooperative Elevator. AmeriSeed. Owned and distributed through ADM Seedwest.

Vista: Full-season. Upright short-vine. "I" gene resistance to BCMV. Can be zinc sensitive.

Developed by Gen-Tec Seeds, Ltd. 1990 Distributed by ADM Seedwest.

Pinto

Sonora: Maturity similar to Maverick. Upright short-vine. Seed count approximately 1400 seeds per pound. Upright medium profile holds pods off ground. AmeriSeed. Distributed by ADM Seedwest.

Windbreaker: Mid-season similar to Buster. Tested as EX 08530762. Bush short-vine. Rust resistant.* "I" gene resistance to BCMV. Seminis Vegetable Seeds.

Cowboy: Tested as 11278. Upright medium profile. Direct harvestable. Improved seed size, with maturity 2 day earlier than Sinaloa. Patented and PVP protected. AmerSeed Distributed by ADM Seedwest.

Sinaloa: Tested as 06203. Maturity 2 to 3 days earlier than LaPaz. Suitable for direct harvest. Approximately 1250 seeds per pound. Patented and PVP protected. AmeriSeed. Distributed by ADM Seedwest.

Torreon: Tested as 06206. Upright short-vine suitable for direct harvest. Mid-season maturity. Average of 1224 seeds per pound. AmeriSeed. Distributed by ADM Seedwest.

Monterrey: Upright, high pod set. USV. Direct harvestable. One day earlier than Lariat. Large seed. Tested as 06185. Released 2012 Developed by ProVita. AmeriSeed. Distributed through ADM Seedwest.

Santa Cruz: Upright short-vine. Direct harvestable. Tested as 06189. Released 2012 Developed by ProVita. AmeriSeed. Distributed through ADM Seedwest.

LaPaz Full-season. Upright short-vine. Direct harvestable. Approximately 1300 seeds per pound. Tested as 99236. AmeriSeed. Distributed by ADM Seedwest.

Vibrant: Tested as 11258. Slow darkening. Upright short-vine. Developed by ProVita. Patented and PVP protected. AmeriSeed. Distributed by ADM Seedwest.

Radiant: Tested as 12324. Upright short-vine suitable for direct harvest. Slow darkening. Approximately 2 days earlier than Sinaloa. Patented and PVP protected. AmeriSeed. Distributed by ADM Seedwest.

Lariat: Maverick maturity plus five days. Upright short-vine. Lineage includes Maverick, Aztec, Winchester, and other experimental lines. Seed slightly larger than Maverick. Rust resistant* "I" gene BCMV resistance. Tested as 0200069. ND Experimental Station 2007.

Black

Eclipse: Mid to full-season. Very narrow profile. Upright short-vine. Dull seed coat. Excellent dry-down. "I" gene resistance to BCMV Tested as ND 9902621-2 ND Ag. Exp. Station. 2004.

Shania: Mid to full-season. Narrow, upright profile. "I" gene resistance to BCMV and resistant to rust.* Improved white mold tolerance. Tested as B201240. Owned and distributed by ADM Seedwest.

Black Cat: Upright short-vine. Tested as 06252. Loreto type structure; two days earlier than T-39. Suitable for direct harvest. AmeriSeed. Distributed by ADM Seedwest.

Loreto: Maturity similar to T-39. Upright profile, suitable for direct harvest. Seed size and color comparable to T-39. "I" gene for resistance to BCMV, UR3 gene for rust resistance.* AmeriSeed. Distributed by ADM Seedwest.

Black Bear: Upright with medium to tall height. Maturity similar to Zorro. Tested as 12576. Developed by ProVita. AmeriSeed. Distributed by ADM Seedwest.

Black Tails Eclipse maturity plus 2 days. Broad and upright. Tested as 13489. Favorable canning characteristics. Good uniform seed size and shape with a slightly rounder oval shape. Developed by ProVita. AmeriSeed. Distributed by ADM Seedwest.

Zorro: Michigan State University. 2009. Tested as B04554. Selected for drought tolerance and common blight resistance. Type II USV. Full season. Seed size, shape and color similar to T-39. High yield.

Zenith: Full season USV developed by MSU AgBioResearch. Released 2014. Good seed color retention. Maturity may be an issue in Mn-Dak region. Later than Zorro.

* Rust resistance is limited. A new strain of rust capable of overcoming the Ur3 gene was discovered in Traill County, ND in 2008.
For a more in-depth discussion, see page 7.

NEW AND PROMISING VARIETIES FOR 2018 AND BEYOND

All can be seen at ADM Varietal Trials in 2018

Navy

06063: High yield with favorable maturity adaptable to multiple regions. Medalist maturity plus two days. ADM Seedwest. Seed available for 2018.

08077: Mid-season maturity suitable for direct harvest. ADM Seedwest.

12047: Very favorable yield with possible white mold suppression. ADM Seedwest.

Pinto

Cowboy: Tested as 11278. Upright medium profile. Direct harvestable. Improved seed size, with maturity between Sinaloa and LaPaz. Patented and PVP protected. ADM Seedwest.

Three new slow-darkening pintos being developed by ProVita with improved agronomic and canning qualities. To be further tested and distributed by ADM Seedwest.

Black

Black Bear: Upright with medium to tall height. Maturity similar to Zorro. Tested as 12576. Developed by ProVita. AmeriSeed. Distributed by ADM Seedwest.

Black Tails Eclipse maturity plus 2 days., Broad and upright. Tested as 13489. Favorable canning

characteristics. Good uniform seed size and shape with a slightly rounder oval shape. Developed by ProVita. AmeriSeed. Distributed by ADM Seedwest

Zenith: Developed by MSU AgBioResearch. Tested as B10244. Released 2014. Upright full-season with high pod set suitable for direct harvest. Good canning quality.

FERTILIZATION

1. Soil test for fertilizer needs. Fertility levels are important. Try to fertilize according to soil test.

2. STARTER APPLICATIONS — DO NOT APPLY more than 5 pounds per acre total N + K_20 in direct contact with seed. Starter fertilizers should contain higher amounts of phosphorous, which can be beneficial especially in colder soils.

3. PLANTER APPLIED — With high levels of fertility, starter fertilizer alone should be sufficient.

4. BROADCAST — If large amounts of fertilizer are needed — this method is preferred. Ideally it should be plowed down in the fall so it will be mixed into the plow layer.

5. NITROGEN — It is generally felt edible beans will respond favorably to nitrogen application. Inadequate nitrogen levels will result in decreased yields; while some research shows excessive nitrogen levels delay maturity and promote disease incidence. Recent research from NDSU has shown that nitrogen levels above 70 pounds per acre give little or no economic return. Consequently, due to these findings and inflated nitrogen prices, nitrogen recommendations have been revised.

   Nitrogen for irrigated beans - Inoculation is not recommended for beans under irrigation. Higher yields demand higher levels of nitrogen. Since irrigated soils tend to be course and well drained, a split application of nitrogen is preferred.

See page 25

6. ZINC — The importance of zinc, especially in regards to navy beans, cannot be over-emphasized. When deficient, both yield and maturity suffer.

   All soils with a pH of 7.0 and above should be tested for zinc. If below 1.0 ppm, the best corrective measure is a broadcast application of zinc sulphate. This form of zinc is slow to release, and will often benefit the subsequent crop. If there is a borderline situation, 2 quarts of zinc chelate per acre can be mixed with your preplant incorporated herbicide.

   Zinc deficiencies can be recognized in the young growing plants as a bronze haze over the field; primarily causing a yellowing or interveinal chlorosis of the older leaves. New leaves will be small and possibly mottled. Emergency treatment of zinc chelate or sulfur based zinc can be applied at this point. Manufacturer's directions should be followed for rates of treatment. Any foliar application should, however, include a minimum of 0.2 lbs./A of actual zinc.

Follow Manufacturer's Label Instructions

ZINC RECOMMENDATIONS

Soil test level (ppm)	Zinc Application (lb./acre)
0 - .30	10
.31 - .60	8
.61 - 1.00	5
1.10 - 2.00	2
2.0+	0

Special conditions:

pH is greater than 7.5	Add 1 lb. zinc/acre
pH is greater than 8.0	Add 2 lb. zinc/acre
Phosphorus is greater than 40	Add 1 lb. zinc/acre

Source: AGVISE Benson, MN

NITROGEN RECOMMENDATIONS

(see page 23)

Dry Land Beans

Inoculated: 40 pounds per acre minus soil test nitrogen

Non-inoculated: 70 pounds per acre minus soil test nitrogen

Irrigated Beans

Recommended nitrogen = yield potential x .05 soil test nitrogen minus previous crop credit

Follow manufacturer's label instructions.

Phosphorous and Potassium Recommendations

Soil test phosphorous ppm							Soil test potassium ppm		
	VL	L	M	H	VH		VL	L	M
Bray P1	0-5	6-10	11-15	16-20	21+		0-40	41-80	81-120+
Olsen	0-3	4-7	8-11	12-15	16+				
	lb P_2O_5/acre						lb K_2O/acre		
	45	30	20	10	0		50	20	0

Source (N, P, & K recommendations): Fertilizing Pinto, Navy, and Other Dry Edible Beans. Franzen, David NDSU Extension Service SF-720 2006

WEED CONTROL

Early season weed control is essential for maximum yield. Studies show weeds left longer than the first three weeks of the growing season dramatically affect yield. Late season weeds hinder harvest operations and can lower quality. Dry beans are a specialty crop; proper weed control is a major factor involved in a high quality product.

CHEMICAL

1. Proper weed identification is critical for control. Make every effort to properly identify weeds and treat at proper stage of plant growth.
2. Apply chemicals according to label recommendations.

MECHANICAL

1. Work seed bed the same as for soybeans.
2. Before weeds emerge (white stage) consider using a rotary hoe or spring tooth harrow. Many growers will continue to rotary hoe, even after beans emerge.
3. Cultivate as needed. As the season progresses, be careful of pruning roots – especially during blooming. If beans are going to be pulled, the rows should be hilled the last cultivation – but if you plan to swath or straight combine, keep field level.
4. Remaining weeds should be hand pulled.

CHEMICAL RECOMMENDATIONS

Suggestions for chemical control of weeds in dry edible beans are listed on the following two pages. Application rates are on a broadcast basis. The rates in the second column refer to acid equivalent or active ingredient. The rates in the third column refer to the amount of commercial product. Avoid repeated and prolonged contact with herbicides, especially direct contact with skin and eyes. Check and follow label restrictions for use of crops for food or feed. Follow manufacturer's label instructions.

IMPORTANT! Today's consumer considers edible beans as a natural, healthy product, requiring minimal processing without additional food preservatives. It is essential we as an industry provide them with what they seek. Use of off-label pesticides is strictly prohibited and positively illegal. We now have an adequate selection of safe, effective, and labeled pesticides to choose from; to do otherwise will result in product refusal and possible legal action.

Glyphosate

In 2004 Monsanto received a Section 3 label for Roudup Original Max (glyphosate) in edible beans, to be used for preharvest control of weeds only, not as a preharvest desiccant. More recently, other formulations have been labeled, including those sold under the trade name: Roundup WeatherMax, Glyphomax Plus, Glyphomax XRT, Durango, Durango DMA, and others. Legal use requires that the

beans themselves must be under 30% moisture, which generally occurs when 80 to 90% of the original leaves have dropped. It cannot be overemphasized that glyphosate cannot be used as a desiccant; doing so can result in higher than allowable glyphosate residues in the beans, potential rejection from processors, legal fines, and long term negative repercussions to the dry bean industry. Please, as with all other pesticides, follow the label instructions.

Contact your ADM agronomist before using glyphosate at harvest time! Use only labeled formulations.

RECENT & PENDING LABEL CHANGES (2-1-18)

To stay abreast of current and changing pesticide labels and regulations, contact your ADM Edible Bean agronomist. The following is a partial list of current issues related to edible bean production.

Quash (metconazole) by Valent has been labeled for white mold control in dry beans. As with other fungicides applications should be made when conditions favor disease development but prior to infection. Consider a second application 7 to 10 days later. See rates under *Desiccant Quick Sheet* page 68.

Basagran (bentazon) from BASF has been reformulated to a 5L or five pounds ai./gal. Generic bentazon is 4L. Consequently recommended Basagran rate is now .4 to 1.6

pint per acre. Although still labeled, Rezult (Basagran and Poast) will no longer be manufactured. A good selection of post-applied grass control products are available. *For a better listing see Labeled Herbicides for 2018 on page 33*. When applying a broadleaf herbicide a split application separated by several days is often recommended. Consult specific label for instructions and follow manufacturer's directions.

Varisto (bentazon & imazamox) from BASF received a label in early 2016 for postemergence control of small grasses and broadleaf weeds. Apply after first trifoliate but prior to flowering. Addition of 1 to 2 pt. oil additive required. Apply to actively growing weeds; do not apply when bean plants are under stress. PHI 30 days. Consult specific label for instructions.

Spartan Elite (s-metolachlor & sulfentrazone) from FMC received a 24(c) Special Local Need label for dry edible beans, preplant or early preemergence. This label applies only to North Dakota and Minnesota. Spartan Elite should not be used on course textured soils or soils less that 1.5% organic matter, rates should be based upon soil type and pH. Rainfall required for herbicide activation. User assumes all responsibility in the case of crop injury. Do not use in a sugarbeet rotation. Spartan Elite is active on kochia (ALS, glyphosate, and Triazine resistant), eastern black nightshade, redroot pigweed, common and tall waterhemp, common lambsquarters, barnyard grass, and foxtails.

See label for further information.

WEED CONTROL – SPECIAL CONSIDERATIONS:

Basagran:

Basagran 5L herbicide (BASF) is a very widely used and effective herbicide in edible bean production. However, for increased efficacy, consider split applications. Full labeled rate is 1.6 pt. per acre broadcast. Timely multiple applications of twice at .8 pt. per acre, three times at .53 pt. per acre., and even four times at .4 pt. per acre significantly increase phytotoxicity on such hard to control weeds as redroot pigweed, lambsquarters, and kochia. Apply to very small, actively growing weeds. Refer to label for more complete directions.

Nightshade control:

Three different nightshades are becoming a very serious problem in the Northarvest area: eastern black, hairy, and cutleaf nightshade. Not only can this weed cause significant yield loss, the problems it creates at harvest time can render the beans unusable and lead to total rejection. Learn to recognize nightshade and learn to avoid it. Eastern black and hairy nightshade look very similar, but the leaves and stems of hairy are covered with fine hairs, eastern black has no hairs. The berries of eastern black turn purple at maturity, while those of hairy remain green. All three species are members of the Solanaceae family, and have the distinctive flower resembling those of the potato and tomato. All are annuals, and rely solely on seed production for reproduction. It is not uncommon for one plant to produce 200,000

seeds, and remain viable in the soil for ten years. To control nightshade, total lack of any seed production is mandatory. Once detected in the field control options are limited, hand removal being the only effective means for large plants. For an excellent review of nightshade and its control, refer to NDSU Circular W-253: North Dakota Weed Control Guide.

Raptor, Pursuit, and Reflex:

Enhanced weed control – namely for such hard to control weeds as common lambsquarters, redroot pigweed, common ragweed, nightshades, and others is now possible with the labeling of Raptor, Pursuit, and Reflex herbicides, yet all three can lead to extensive crop damage under certain conditions. Do not apply before the first trifoliate is fully expanded or once flowering begins. Do not apply when beans are under any type of stress such as drought, excessive heat or cold, very wet soils, or when stress may occur within the next seven days. The addition of Basagran – even five fluid ounces – will act as a "crop safener," slowing the uptake of Raptor and Pursuit. Certain crop oils in combination with hot weather can cause severe leaf burn when using Reflex. Labeled rates vary with geographic location, and some crop rotations preclude the use of Raptor and Pursuit. Please consult your ADM agronomist for further questions. Always refer to the herbicide label and follow directions.

Follow Manufacturer's Label Instructions

Herbicides Labeled for Dry Edible Beans (2-1-18)
MN & ND Only

Chemical	Active Ingred.per acre (Broadcast)	Product/Acre Broadcast	Time	Remarks
		EARLY PREPLANT BURNDOWN		
RoundUp, Generic (glyphosate)	0.75 to 3.0lb. ae	2.0 to 8.0 pts. of a 3 lb ae/gal conc.	Preplant to prior to crop emergence	Nonselective Various formulations
Gramoxone (paraquat)		Follow Label	Preplant to prior to crop emergence	Nonselective
		PPI & PRE SOIL APPLIED		
Treflan, etc. (trifluralin)	0.5 to 1.0 lb.	1 to 2 pts. EC 5 to 10 lbs. G	Preplant incorporated (Fall granules)	Must be well incorporated
Eptam (EPTC)	3.0 to 4.0 lb	3.5 to 4.5 pts 15 to 20 lbs. G	Preplant incorporate	Incorporate immediately
Eptam & Treflan	2.2 to 3.0 lb. +0.5 to 1.0 lb.	2.5 to 3.5 pts. 15 to 20 lbs. + 1 to 2 pts. 5 to 10 lbs.	Preplant incorporate	Incorporate. Use higher rates Eptam granules in fall.
Prowl, Prowl H_2O (pendimethalin)	1.0 to 1.5 lb.	2.4 to 3.6 pts. 3.3 EC 2.1 to 3.0 pt. 3.8 ACS	Preplant incorporated	Must be well incorporated. Consider Soil Organic Matter.
Sonalan (ethalfluralin)	0.6 to 1.7 lb.	1.5 to 4.5 pts. EC 5.5 to 17.0 lbs. 10G	Preplant incorporated	Use high rate for nightshade control

Read and follow herbicide application instructions.

Herbicides Labeled for Dry Edible Beans (2-1-18)
MN & ND Only

Chemical	Active Ingred.per acre (Broadcast)	Product/Acre Broadcast	Time	Remarks
Eptam & Sonalan	2.2 to 3.0 lb. + 0.48 to 1.1 lb.	2.5 to 3.5 pt 11 to 15 lb. 20G + 1.25 to 3.0 pt. 4.8 to 11 lb. 10G	Preplant incorporated	PPI immediately Poor on wild mustard
Intrro (alachlor)	2.0 to 3.0 lb.	4.0 to 6.0 pt.	Preplant incorporated	Must be incorporated Use higher rates for nightshade control
Dual II Magnum, Generic Metolachlor (S/metolachlor)	0.95 to 1.9 lb.	1.0 to 2.0 pt.	PPI spring PRE fall after Sept. 30	PPI can improve weed control
Outlook, Generic Dimethenamid (dimethenamid-P)	0.75 to 1.0 lb.	16 to 21 fl oz EC	PPI, PRE, or early post	Good nightshade control. No activity on emerged weeds
Spartan Elite (S-metolachor & sulfentrazone)	0.98 to 1.28 lb. & 1.75 to 2.25 oz.	20 to 26 fl oz EC	Shallow PPI or PRE	Caution. User assumes all risk. See page 29.
Permit (halosulfuron)	0.38 to 0.5 oz	0.5 to 0.67 oz. DF	Shallow PPI or PRE	Best used Pre. **Post up to flowering.** Active on volunteer soybeans. See page 6 and 67.
Halomax 75 (halosulfuron- methyl)	0.0235 to 0.031 oz.	.5 to .67 oz	After planting before emergence	May need rainfall for activation
Pursuit (imazethapyr)	.75 oz. .5 oz.	S. MN & E. SD: 3 fl. oz. N. of Hwy 210 MN & ND: 2 fl. oz.	PPI or PRE	Good on wild buckwheat.

Read and follow herbicide application instructions.

Herbicides Labeled for Dry Edible Beans (2-1-18)
MN & ND Only

Chemical	Active Ingred.per acre (Broadcast)	Product/Acre Broadcast	Time	Remarks
Spartan Charge (carfentrazone & sulfentrazone)	0.16 to 0.25 oz & 1.48 to 2.26 oz	3.75 to 5.75 fl oz SE	Shallow PPI or PRE	Avoid use on course soils. See page 28
		POST-APPLIED		
Pursuit (imazethapyr)	0.75 oz. 0.5 oz.	S. MN & E. SD: 3 fl oz N. of Hwy 210 & ND: 2 fl oz	After first trifoliate but before flowering See Label	Rate dependent on location. Do not apply under stress. One app. per season.
Permit (halosulfuron)	0.38 to 0.5 oz.	0.5 to 0.67 oz. DF	1 to 3 trifoliates, before flowering	ND & MN only SLN label
Halomax 75 (halosulfuron- methyl)	0.0235 to 0.031 oz.	0.5 to 0.67 oz	1 to 3 trifoliates, before flowering	ND & MN only SLN label
Basagran 5L/ Generic bentazon	0.25 to 1.0 lb.	0.4 to 1.6 pts.	Early post-emergence	Consider multiple applications. See Page 29
Varisto (bentazon + imazamox)	0.34 to 0.66 lb. + 0.26 to 0.5 oz	11 to 21 fl oz SL	After 1st trifoliate, prior to flowering	Add oil adjuvants at 1 to 2 pt/A MSO best.
Raptor (imazamox)	0.5 oz ae	4.0 fl. oz.	Post After first trifoliate	NIS at .25% COC or MSO at 1.0-2.0%
Reflex (fomesafen)	0.19 to 0.25 lb.	12 fl. oz. (ND & south Hwy 2 MN) 16 fl. oz. (MN south of I-94)	Post Before flowering	.5 - 1.0% MSO or COC v/v

Read and follow herbicide application instructions.

Herbicides Labeled for Dry Edible Beans (2-1-18)
MN & ND Only

Chemical	Active Ingred.per acre (Broadcast)	Product/Acre Broadcast	Time	Remarks
Assure II, Targa (quizalofop)	0.77 to 1.1 oz.	7 to 10 fl. oz.	Post PHI 30 day	Add oil at 1 qt./A
Fusilade DX (fluazifop)	1.25 to 3.0 oz.	5 to 12 fl. oz.	Post PHI 60 day	Add oil at 1 qt./A
Poast (sethoxydim)	0.1 to 0.3 lb.	0.5 to 1.5 pt	Post PHI 30 day	Add 1 qt./A crop oil
Select Max 1EC, Select 2EC (clethodim)	1.0 to 2.0 oz	9 to 16 fl oz EC. 4 to 8 fl oz EC. Label specific	PHI 30 day	Add oil at 1 qt./A Higher Rates for perennial grasses. Consult specific label
		PREHARVEST see Using Desiccants page 63		
Drexel Defol 750 (sodium chlorate)	6.0 lb.	3.2 qt.	7 day PHI	Thorough coverage essential.
Gramoxone, Inteon (paraquat)	0.3 - 0.5 lb	1.2 - 2.0 pt.	7 day PHI	Avoid drift. 0.25 to 0.5% NIS or 1% MSO
Sharpen (saflufenacil)	0.36 to 0.72 oz	1.0 to 2.0 fl oz	2 day PHI	Aply with 1 pt./A MSO & 8.5 lbs. AMS/100 gal
Valor SX, Valor EZ (Flumioxazin)	1.0 to 1.53 oz	2.0 to 3.0 oz. WDG 2.0 to 3.0 fl. oz. SC	5 day PHI	Apply with 1 qt/A MSO
RoundUp, Generic (glyphosate)	0.75 ae	various	7 day PHI Used as weed control only	Not a desiccant. See page 28 for further information
Others				

Source: 2018 ND Weed Control Guide NDSU Extension Service Circular W-253 2017
Read and follow herbicide application instructions.

E=Excellent
G=Good
F=Fair
P=Poor
N=No control
— insufficient information

HERBICIDE EFFECTIVENESS ON WEEDS IN EDIBLE BEANS*

	GRASSES									BROADLEAF															
	Giant Foxtail	Green Foxtail	Yellow Foxtail	Barnyardgrass	Nutsedge	Fall Panicum	Quackgrass	Wild Oats	Volunteer Cereals*	E. Bl. Nightshade	Hairy Nightshade	Lanceleaf Sage	Wild Buckwheat	Cocklebur	Lambsquarters	Wild Mustard	RR Pigweed	Common Ragweed	Smartweed	Velvetleaf	Bla. Wormwood	Wild Sunflower	Kochia	*Canada Thistle
Eptam	E	E	E	E	F	E	F-G	G-E	G	F	F	N	F	P	F	P	G	F	P	F	N	N	P	N
Treflan	E	E	E	E	N	E	N	P	N-P	N-P	N-P	N	P	N	F-G	N	E	N	P	N	N	N	P	N
Prowl	E	E	E	E	N	E	N	P	N-P	N-P	N-P	N	P	N	F-G	N	E	N	P	F	N	N	P	N
Soalan	E	E	E	E	N	E	N	P	N-P	N-P	N-P	N	P	N	F-G	N	E	N	P	N	N	N	P	N
Intrro	G	G	G	G	G	N	N	F	—	P	G	N	P	N	F	P	G	P	P	P	N	N	F	N
S-Metolachlor	E	F-E	F-E	P-E	G	G	N	P-F	P	N	N	N	N-P	N	P-F	N	F-G	N	N	N	N	N	N-P	N
Outlook	E	E	E	E	F	G	N	P	F-G	F-G	F-G	N	N	N	F-G	P-F	G-E	N	N	N	N	N	N	N
Spartan Charge	N	P	P	N	F	N	N	N	N	E	F-E	N	P-F	P	G-E	P	F-E	N	G-E	N	G	N	F-E	N
Permit (PPI)	N	N	N	N	F	N	N	N	N	N	N	—	N	E	G-E	E	F-E	E	E	G	N	—	N	N
Spartan Elite	E	F-E	F-E	P-E	G	G	N	N	P-F	G-E	F-G	N	P-G	P	E	P	G-E	N	G-E	P	F-G	N	E	N
Basagran	N	N	N	N	G	N	N	N	N	N	F-G	P	P-G	G-E	F-E	E	F-E	P-F	E	G	G-E	E	P-E	F-G
Raptor	F	E	G-E	E	P	P	F	E	G-E	E	E	E	P	G-E	P-F	E	E	N	G-E	G	P	E	E	N-P
Pursuit***	F	G	F-G	G	F	F	N	F	G	E	E	E	P	G-E	P	E	E	N	G-E	F	N	G-E	E	N
Varisto	F	E	G-E	E	F	P	F	E	G-E	E	E	E	P-G	E	F-E	E	E	P-F	E	G	G-E	E	E	F-G
Reflex	N	N	N	N	N	N	N	N	N	G	P	E	P	G-E	P-F	E	G-E	P-E	G-E	P	P	P-F	F-E	N
Assure II	E	E	F-G	E	N	E	E	G-E	E	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Fuslidade DX	E	G-E	G-E	E	N	E	G	E	E	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Poast	E	E	E	E	N	E	F	G-E	G-E	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Select Max	E	E	E	E	N	E	G-E	E	E	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

*Size of weeds, environmental condition, and single vs. split application will have a marked influence.
** For volunteer corn Assure II provides superior control.
***Pursuit efficacy is dependent upon rate, as labels very with geographic location. See label for specifics.
PPI increases weed control of Intrro, S-metolachlor, Permit, and Outlook vs. preemergence.

Effects of Common Herbicides on Beans

Herbicide Class/Family	Trade Name	Bean Injury Symptoms
Dinitroanaline	Treflan, Sonalan, Prowl	General Stunting, Partial emergence from soil Short, thick lateral roots, Swollen & cracked hypocotyl
Chloroacetamide	Dual, Lasso, Frontier	Crinkled & puckered leaves, General stunting
Carbamothioate	Eptam	Shortened leaf mid-vein, producing '"drawstring" effect
Imidazolinones	Pursuit	Minor stunting, Chlorotic leaves, Possible delayed maturity
Benzothiadiazole	Basagran	Leaves turning yellow or brown, Necrosis of affected leaf New leaves unaffected
Cyclohexane-1,3 diones	Poast, Assure II, Select	Minor yellowing possible, Possible white blotches. New growth unaffected
Growth regulators- Phenoxy acetic acid, Benzoic acid, Picolinic acid	2,4-D, MCPA,Banvel, Tordon, Stinger	Epinasty (stem twisting), Formation of callus tissue Leaf cupping & crinkling, Shortened internodes
Photosynthesis Inhibitors- Triazines, Substituted Ureas, Uracils	Atrazine, Bladex, Lexone, Sencor	Germination & emergence not affected Initial yellowing of bean leaf margins Injury more severe in older leaves, Eventual necrosis Injury more severe in high pH soils
Bipyridylium, Diphenylethers	Gramoxone, Blazer, Reflex	Dead spots on leaves Leaf desiccation
Amino acid derivatives, Sulfonylureas, Sulfonamide	Roundup, Accent, Ally, Harmony, Broadstrike	Roundup affects new growth first: yellowing, browning, death Others: stunting, interveinal chlorosis, or veins turn purple

Source:

Dry Bean Production & IPM for the High Plains Region
XCM09 Colorado State University Cooperative Extension 1997
Herbicide Symptoms in Dry Edible Beans
Ext. Folder 540-1980 University of Minnesota

PLANTING

1. Plant seed after soil temperatures reach 52-55 degrees F. or higher.

2. This will usually be May 5 to June 1st. Planting later than June 10th may decrease yields slightly, while beans should not be planted later than June 15th, except in southern growing areas.

3. Shallow planting of 1-2 inches is generally best if seed is in moisture — 3 inches would be the maximum.

4. If a soil crust forms at time of emergence, it is advisable to use a rotary hoe or some other suitable tool to break the crust.

5. Conventional planting equipment is sufficient for planting edible beans.

6. Use powdered graphite in the planter box as a lubricant.

7. On air planters tie brushes in drum back or remove them to prevent damage to the seed.

8. **Air seeders: Planting edible beans with an air-seeder is not recommended. Should no other alternative be available, reduce air pressure, increase seeding rate, pad distribution plate, and plant at your own risk.**

PLANTING RATES

NAVY & BLACK BEAN

Commercial navy and black bean varieties are predominantly of a bush short-vine or an upright short-vine type structure, facilitating direct harvest as well as other agronomic advantages such as disease avoidance. In conventional 30

inch rows seeding 100,000 seeds per acre or 1.0 unit is recommended. In 22 inch rows a seeding rate of 110,000 to 120,000 or 1.1 to 1.2 units per acre is optimal, while a 12 inch or narrower row will require rates of nearly 140,000 or 1.4 units per acre.

PINTO BEAN

Traditional pinto varieties tend to be a vine type structure and are normally planted in wider, 30 inch rows to facilitate cutting/windrowing at harvest. Newer cultivars are more compact and upright, being either a bush short-vine (BSV) or upright short-vine (USV); many growers have chosen to use narrower 22 inch rows for this type of structure. In 30 inch rows, seed 65,000 to 70,000 seeds or .65 - .7 unit per acre; in 22 inch rown increase seeing rate to 75,000 to 80,000 seeds or .75 - .8 unit per acre.

Refer to page 41: Precision Planting

CHECKING PLANT POPULATION

To estimate plant population, use the table below. 1) For your particular row width, count the number of plants in the length given to equal 1/1000 of an acre 2) Randomly check the field in several spots, counting the plants in that distance, and then average the counts 3) Multiply the average by 1000 to get an estimated population per acre.

Row Width	Row Length for 1/1000 acre
6"	87'1"
22"	23'9"
30"	17'5"
36"	14'6"

Precision Planting

One unit of dry bean seed = 100,000 seeds

Example:
- Navy bean, 22 inch row, planting 120,000 seeds per acre = 1.2 unit per acre
- 100 acres requires 120 units

- Pinto bean, 22 inch row, planting 75,000 seeds per acre = .75 unit per acre
- 100 acres requires 75 units

Reccomended Minimum Live Plants per Acre

CLASS	6"	12"	22"	30"	36"
PINTO	90,000	85,000	75,000	65,000	55,000
NAVY	140,000	140,000	115,000	95,000	90,000
BLACK	140,000	140,000	115,000	95,000	90,000

PLANT SPACING — Inches between Seeds Down a Planted Row

PINTO BEANS

Approximate Units Per Acre	Seeds Per Acre	Row Width 6"	12"	22"	30"	36"
.65	65,000	16.7	8.4	4.6	3.3	2.8
.75	75,000	14.0	7.0	3.8	2.8	2.3
1.0	100,000	10.4	5.2	2.9	2.1	1.7
1.25	125,000	8.4	2.3	2.3	1.7	1.4

NAVY & BLACK BEANS

Approximate Units Per Acre	Seeds Per Acre	Row Width 6"	12"	22"	30"	36"
.75	75,000	14.0	7.0	3.8	2.8	2.3
1.0	100,000	10.4	5.2	2.9	2.1	1.7
1.25	125,000	8.4	4.2	2.3	1.7	1.4
1.5	150,000	7.0	3.5	1.9	1.4	1.2

REPLANTING

Replanting is seldom advisable. Bean plants are extremely resilient and generally compensate for a weak stand. Research has shown that in most cases plant population can be reduced by up to 30% with little reduction in yield, assuming other factors are favorable. If the replanting issue arises, contact your agronomist for a second opinion.

GROWTH PROBLEMS

BALDHEADS

"Baldheads" are seedlings that have no growing point. Cotyledons may or may not be attached; often they are broken. Stems will commonly come out of the ground and then stop growing and die. This is usually caused by one of three things: seed corn maggot eating on the growing point underground, extreme environmental conditions, or damage caused to the seed by mechanical damage or harsh handling of seed. For best control, use seed treated with Lorsban, plant seed in warm soil, and always handle bags with care.

HAIL DAMAGE

The amount of crop damage caused by hail will depend on the density, size of hail stones, and duration, as well as plant type and stage of development. Determinate (type I) cultivars are likely to suffer greater losses than the indeterminate (types II and III) culitvars, because type II and III can compensate to a greater degree than can the type I.

Severe hail damage can delay plant maturity. The earlier the stage of development at which the injury occurs, the greater the time available for recovery, resulting in less yield reduction. Hail will not directly affect seed quality unless a strike occurs on the pod.

IRRIGATION

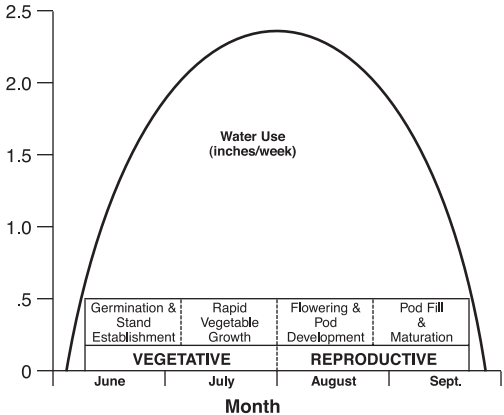
Edible beans have a very high response per unit of water use. A normal crop will require between 12 to 16 inches of water, higher on sandy soils. Research across the Great Plains has demonstrated irrigated beans will outyield non-irrigated beans on some soils. High quality water is a must; water high in soluble salts is not recommended.

About 85% of the water used by a bean crop will be extracted from the top 18 inches of soil. It is essential to start with a full profile to 4 feet, which will provide a reserve in the heat of July, when beans are flowering and extremely sensitive to stress.

Starting with a full profile, the first irrigation should occur 3 to 4 weeks after planting. The second is usually at initial flowering, followed by another 7 to 10 days later, or whenever moisture levels reach 50% of capacity. The crop itself will turn a very dark green when under stress, which usually occurs at this 50% level. Heavy, less frequent irrigations are preferred over lighter more frequent applications. This will maintain a drier soil near the surface and reduce the threat of white mold.

Edible beans should normally not be irrigated after mid-August. Late season water applications can delay maturity.

For further information, refer to Minn. Ext. Bulletin AG-FO-1322: Irrigation Scheduling.



Seasonal water use for dry beans (inches/week).

INSECTS

Although not a frequent problem insects can be an issue depending on production region, environment, cropping history, and other conditions. The most common insects bean growers need to be concerned about are: soil born insects such as seedcorn maggots and wireworms, early season infestations of potato leafhoppers and grasshoppers. Seed treatments will normally control maggots and wireworms. Potato leafhoppers, which can be very devastating in southern Mn-Dak production areas, can be controlled with a seed treatment (Cruiser) and/or foliar insecticide applications. Finally, when grasshoppers become an issue they too can be controlled. In many instances though, a healthy bean crop can tolerate low populations of insects and a spray program isn't warranted. Please consult your ADM agronomist before spraying insecticides unnecessarily.

Spider Mites:

Not a true insect, the two-spotted spider mite *(Tetranychus urticae)* is seldom a pest in dry bean production except during hot dry conditions; some fields do occasionally experience spider mites. These tiny arachnids (less than .002 inch) are nearly impossible to see without magnification. The best method to verify their presence is to hold a white sheet of paper below the leaves, shake the plant, and look for tiny dust- like specks moving on the paper. Damage is first detected as stippling (small yellow spots) and eventually yellow to brown bronzed leaves and finally leaf drop. Webbing is also common.

Traditional insecticides have no effect on spider mites and can often exasperate the problem due to killing of predators; organophosphates being the only effective compounds. However, there is no established threshold established in dry beans, and treatment is usually not recommended. Stage of growth, forecasted weather, and level of infestation must all be taken into account. Before spraying, please contact your ADM agronomist. Unnecessary spraying of insecticides is highly discouraged.

Labeled Insecticides

The following is a **partial** list of insecticides labeled for edible beans. For a more complete listing, refer to ND Extension Report E-1143

Insect	Compound	Insecticide (trade name)	Product per acre	Pre-harvest interval (Days)	Comments
Cutworms Treat when one cutworm or more per 3 ft row and larvae are small	acephate	Acephate 75WSP Acephate 90 Prill Acepthate 90 WDG Acephate 97 Acephtate 97UP Orthene 97	.33 – 1.33 lb 4.4 oz -1.1 lb 4.4 oz. - 1.1 lb .25 – 1.0 lb .25 – 1.0 lb .5 – 1.0 lb	14	
	beta-cyfluthrin	Baythroid XL	.8 – 3.2 fl. oz.	7	
	bifenthrin	Capture LFR Sniper LFR	3.4 – 6.8 fl oz .2 - .39 fl oz / 1000 ft row	14	Broadcast rate 5 – 7 inch band over row for best control
	carbaryl	Sevin 4F Sevin XLR Plus	.5 – 1.5 qts .5 – 1.5 qts.	21	
	esfenvalerate	Asana XL	5.8 – 9.6 fl oz.	21	
	gamma-cyhalothrin	Declare	1.02 – 1.54 fl. oz.	21	
	lambda - cyhalothrin	Warrior 11	1.28 – 1.92 fl oz	21	
	methomyl	Lannate LV	.75 – 3 pts	14	
	Zeta-cypermethrin	Mustang Maxx	1.28 – 4.0 fl. oz.	21	

Insect	Compound	Insecticide (trade name)	Product per acre	Pre-harvest interval (Days)	Comments
Leafhoppers Threshold: one hopper/trifoliate	acephate	Acephate 75WSP Acephate 90 Prill Acepthate 90 WDG Acephate 97 Acephtate 97UP Orthene 97	.33 – 1.33 lb 4.4 oz -1.1 lb 4.4 oz. - 1.1 lb .25 – 1.0 lb .25 – 1.0 lb .5 – 1.0 lb	14	
	beta-cyfluthrin	Baythroid XL	.8 – 3.2 fl. oz.	7	
	carbaryl	Sevin 4F Sevin XLR Plus	.5 – 1.5 qts .5 – 1.5 qts.	21	
	dimethoate	Dimate 400 Dimethoate 400 Dimethoate 4E Dimethoate 4EC	.5-1 pt	0	
	esfenvalerate	Asana XL	5.8 – 9.6 fl. oz	21	
	lambda-cyhalothrin	Grizzly Z Silencer Warrior 11	1.92-3.84 fl oz 1.92-3.84 fl oz 1.28 – 1.92 fl oz	21	
	Malathion	Fyfanon ULV Malathion ULV	8 fl oz	1	
	Methomyl	Lannate LV	.75 – 3 pts	14	
	zeta-cypermethrin	Mustang Maxx	1.28 – 4.0 fl oz	21	

	Compound	Insecticide (trade name)	Product per acre	Pre-harvest interval (Days)	Comments
Armyworms Control when 25% of foliage destroyed or significant pod injury	acephate	Acephate 75WSP Acephate 90 Prill Acepthate 90 WDG Acephate 97 Acephtate 97UP Orthene 97	.33 – 1.33 lb 4.4 oz -1.1 lb 4.4 oz. - 1.1 lb .25 – 1.0 lb .25 – 1.0 lb .5 – 1.0 lb	14	
	Bacillus thuringiensis ssp. kurstaki	Biobit HP DiPel DF DiPel ES Xen Tari DF	.5-2 lbs 1 – 2 lbs 1 – 4 pts .5 – 2 lbs.	0	Control at early instar larvae
	bifenthrin	Capture LFR Sniper LFR	3.4 – 6.8 fl oz .2 - .39 fl oz / 1000 ft row	14	Broadcast rate 5 – 7 inch band over row for best control
	carbaryl	Sevin 4F Sevin XLR Plus	.5 – 1.5 qts .5 – 1.5 qts.	21	
	gamma-cyhalothrin	Declare Proaxis	1.02 – 1.54 f.l oz. 2.56 – 3.84 fl. oz.	21	
	lambda-cyhalothrin	Grizzly Z Silencer Warrior 11	1.92-3.84 fl oz 1.92-3.84 fl oz 1.28 – 1.92 fl oz	21	
	methomyl	Lannate LV	.75 – 3.0 pts.	14	
	zeta-cypermethrin	Mustang Max	1.28 – 4.0 fl oz	21	

Insect	Compound	Insecticide	Product per acre	Pre-harvest interval (Days)	Comments
Grasshoppers Threshold: >20 adults field margin or 8-14 adults in field per square yard. Use 15 inch sweep net to estimate populations	acephate	Acephate 75WSP Acephate 90 Prill Acepthate 90 WDG Acephate 97 Acephtate 97UP Orthene 97	.33 – 1.33 lb 4.4 oz -1.1 lb 4.4 oz. - 1.1 lb .25 – 1.0 lb .25 – 1.0 lb .5 – 1.0 lb	14	
	beta-cyfluthrin	Baythroid XL	.8 – 3.2 fl oz	7	
	carbaryl	Sevin 4F Sevin XLR Plus	.5 – 1.5 qts .5 – 1.5 qts.	21	
	dimethoate	Dimate 400 Dimethoate 400 Dimethoate 4E Dimethoate 4EC	.5-1 pt	0	
	esfenvalerate	Asana XL	5.8 – 9.6 fl oz.	21	Use higher rate for nymphs larger than 2nd instar
	gamma-cyhalothrin	Declare Proaxis	1.02 – 1.54 fl. oz. 2.56 – 3.84 fl. oz.	21	
	lambda-cyhalothrin	Grizzly Z Silencer Warrior 11	1.92-3.84 fl oz 1.92-3.84 fl oz 1.28 – 1.92 fl oz	21	
	zeta-cypermethrin	Mustang Max	1.28 – 4.0 fl oz	21	

Insect	Compound	Insecticide	Product per acre	Pre-harvest interval (Days)	Comments
Foliage Feeding Caterpillars* Treat when >30% of foliage destroyed	acephate	Acephate 75WSP Acephate 90 Prill Acepthate 90 WDG Acephate 97 Acephtate 97UP Orthene 97	.33 – 1.33 lb 4.4 oz -1.1 lb 4.4 oz. - 1.1 lb .25 – 1.0 lb .25 – 1.0 lb .5 – 1.0 lb	14	
	Bacillus thuringiensis ssp. kurstaki	Biobit HP DiPel DF DiPel ES Xen Tari DF	.5-2 lbs ¼ - 1 lb. 1 – 4 pts .5 – 2 lbs.	0	
	beta-cyfluthrin	Baythroid XL	.8 – 3.2 fl. oz.	7	
	carbaryl	Sevin 4F Sevin XLR Plus	.5 – 1.5 qts .5 – 1.5 qts.	21	
	esfenvalerate	Delete Adjourn Asana XL	5.8 – 9.6 fl. oz	21	
	gamma-cyhalothrin	Declare Proaxis	1.02 – 1.54 fl. oz. 2.56 – 3.84 fl. oz.	21	
	lambda-cyhalothrin	Grizzly Z Silencer Warrior 11	1.92-3.84 fl oz 1.92-3.84 fl oz 1.28 – 1.92 fl oz	21	
	malathion	Fyfanon ULV Malathion ULV	8 fl oz	1	
	zeta-cypermethrin	Mustang Max	1.28 – 4.0 fl oz	21	

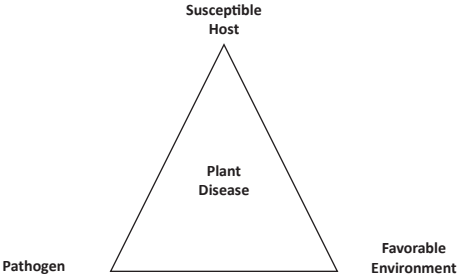
*foliage feeding caterpillars may include green cloverworm, cabbage looper, thistle caterpillar, etc. Treatment is seldom warranted.

Insect	Compound	Insecticide	Product per acre	Pre-harvest interval (Days)	Comments
Spider Mites (not a true insect, spraying decision difficult and often ineffective. Consult agronomist for assistance.)	abamectin	Agri-Mek .15EC Agri-Mek SC	8 – 16 fl oz. 1.75 – 3.5 fl. oz.	7	
	bifenthrin	Bifenture EC Brigade 2EC Fanfare 2EC Sniper Sniper Helios Tundra EC	1.6 – 6.4 fl. oz 1.6 – 6.4 fl. oz 1.6 – 6.4 fl. oz 1.6 – 6.4 fl. oz 1.6 – 6.4 fl. oz 1.6 – 6.4 fl. oz	14	
	bifenthrin + zeta-cypermethrin	Hero	4.0 – 10.3 fl. oz.	21	
	dimethoate	Dimate 400 Dimethoate 400 Dimethoate 4E Dimethoate 4EC	.5 – 1.0 pt. .5 – 1.0 pt. .5 – 1.0 pt. .5 – 1.0 pt. .5 – 1.0 pt.	0	
	naled	Dibrom 8 Emulsive	1 – 1.5 pts.	1	

Source: ND Field Crop Insect Management Guide for 2018 Extension Report E-1143 December 2017

DISEASE PREVENTION AND CONTROL

Dry beans, like any other crop, are susceptible to disease when conditions are right. Prevention is the key; once detected, most bean diseases are difficult to control. As shown in the diagram, any disease is dependent upon three factors. When close attention is given to all cultural practices, such as quality seed, proper variety selection, adequate fertility, and proper weed control, the triangle is broken and diseases are held in check.



Plant Disease Triangle

Disease and Integrated Pest Management

As agriculture continues to change, the understanding of biorational products continues to be integrated into many of the large multi-national companies. Biorational products are expected to grow at a compounded annual growth rate of 12%. As consumers continue to want to know more about what is applied to their food, farmers need to be knowledgeable on fungicides that will comply with stricter regulations against maximum residue levels. One fungicide

that is getting a lot of interest in the edible bean, soybean, and sunflower market is a product called Contans WG which is distributed by SipcamAdvan. Contans WG is a living fungus that is very specific at reducing the amount of white mold. Contans is applied to the soil and attacks sclerotinia sclerotiorum which is the source of white mold.

While many growers tend to spray fungicides during the flowering period, Contans WG is applied to the soil targeting the host organism of white mold. It is very important to look at this disease with an IPM (Integrated Pest Management) approach. An Integrated Pest Management approach allows growers to implement a system that helps reduce the amount of white mold with multiple modes of action.

Contans WG continues to provide grower's with the satisfaction of knowing that they are reducing the source of the disease versus spraying fungicides too late in the season.

Scott Peterson

Root Rot – Root rot is a chronic problem caused by several soil borne fungi. The two most common types in the Northarvest area are Fusarium and Rhizoctonia root rots. Fusarium root rot is the most common and also most serious in drought years. Symptoms usually appear 4-5 weeks after planting, seen as a reddish discoloration of the taproot and stem below the soil line. The central pith of the infected tap root is often a bright red. Rhizoctonia root rot produces reddish-brown sunken cankers on the root and hypocotyl. Rhizoctonia can be more severe when following sugarbeets.

Control: Extend crop rotation to four years. Include small grains in rotation. Avoid sugarbeets in close rotations.

Keep soil cultivated as close to stems as possible without causing serious pruning. Hill plants to encourage lateral roots above the infected areas.

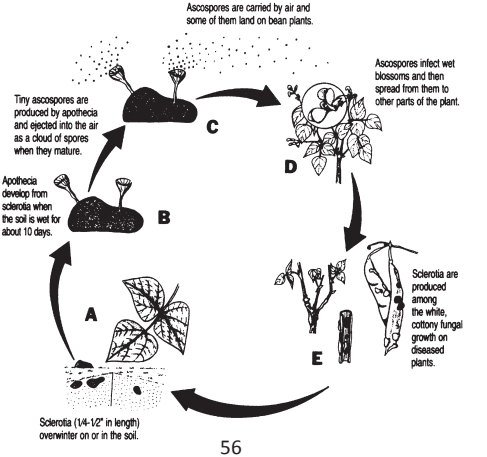
Bacterial Blight – Three main types of blight exist in the Northeast region, all caused by bacteria. Blights are seed borne, and spread by driving rains. Damaged plants are more prone to infection. The most prevalent is Common Blight. Large irregular-shaped lesions surround a distinct yellow zone. Bacterial Brown Spot is another, manifested as brown lesions on the leaves, with the centers eventually falling out, giving the plant a very ragged appearance. Brown Spot seems to affect certain varieties more severely and often follows a hail damaged field. Halo Blight, the third type of blight, is not as common in Mn/Dak.

Control: Plant western grown seed, which is produced under strict production standards to provide minimal levels of seed borne disease. Follow three year rotations. Avoid entering fields when wet. Chemical control is ineffective.

Rust – Dry bean rust is a defoliating fungal disease and unique in the fact it can over-winter in our Northarvest region. Surviving as teliospores on crop residue during winter months, basidospores are then produced during the growing season leading to disease outbreaks and possible multiple infections, typically occuring as hot spots or even infections fieldwide. Since free moisture is required for spore germination, the disease is favored by periods of late season -normally August- dew, fog and rain. Favorable temperatures range from 65 to 85 degree F.; higher temps tend to suppress further spread.

Control: While most varieties grown in our region hold resistance to older races of rust, a new race was identified in 2008, consequently all commercially grown varieties are now considered susceptible to some extent. Crop rotation and control of volunteer beans is essential. Scout fields on a regular basis, being particularly vigilant in areas apt to remain damp later in the day as well as those areas close to bean fields from the previous season where rust was detected. Several excellent foliar fungicides are available (pages 58-63), but early detection and spraying is essential. Multiple applications may be required, although once bean fields are within one month of harvest, detected as when pinto pods begin to stripe or in other classes pods begin to turn buckskin, treatment is no longer necessary. Should initial infections occur very late in the season - again when the field is within 30 days or harvest - treatment is normally not necessary.

Life Cycle: *Sclerotinia sclerotiorum*



White mold – Also known as Sclerotinia, this fungal disease is complicated and often unpredictable. Caused by the fungus *Sclerotinia sclerotiorum*, the disease is widespread throughout the United States, and affects many vegetable and field crops, as well as common weeds. Small, hard bodies called sclerotia are produced in diseased plants, surviving in the soil for up to ten years. When conditions are right – namely 10 days of continuously wet soils and moderate temperatures, these sclerotia germinate into tiny mushrooms called apothesia. Apothesia then produce millions of spores, which blow considerable distances and infect host plants such as beans. Symptoms are first seen as small, soft, watery spots on stems, pods, and leaves. These lesions quickly enlarge to become white moldy growth, arresting further development on all or part of the plant. Losses can be very substantial. See diagram on page 56.

Control: Rotation is of limited value in this disease, because spores can blow from neighboring fields. Plant upright varieties when possible. If fields have a history of white mold, consider wide rows since air movement helps dry bean plants and slow disease progression. **However, the most important factor to consider is the amount of rainfall occurring the ten days before flowering begins, and the ten days after.** If more than two inches of rain are received in this period, and yield potential is above 2000 lbs/A, spraying may be warranted. Spray by ground whenever possible, at early flowering. Use large volumes of water to assure adequate coverage, and direct spray towards the bottom half of plant. Thorough coverage of flowers, especially the early flowers, is critical. The key to controlling white mold with chemicals is: spray early – long before the disease is seen, and spraying in the right manner, namely by ground whenever possible. Please consult your agronomist for further guidance. Refer to pages 59-60.

Bean Anthracnose – Anthracnose is predominately a seed-transmitted fungal disease, caused by *Colletotrichum lindemuthianum*. While dry beans have been commercially grown in the Mn-Dak area for nearly forty years, it is only recently that anthracnose has become a real concern, mainly in the very northern sections of the Red River Valley, Devils Lake basin and to the south. Use of bin-run seed and tight rotations have been the impetus for this outbreak; in some cases beans have been planted on the same ground several years in a row. The disease can survive in a field as long as infected bean residue is present, while seed treatment and foliar fungicides are able to provide limited protection. Sound agronomic practices, including a three year rotation **and planting western grown seed** have been well documented to be the best approach to preventing this devastating disease.

See Athracnose Alert page 11

Edible Bean White Mold Fungicides
Timing: *One* Application

Compound (Trade Name)	Manufacturer	Mode of Action	Proper Timing*	PHI
Topsin	UPI	Local systemic	100% bloom	28
Endura	BASF	Local systemic	Early bloom	21
Proline	Bayer	Systemic	25% bloom	7
Omega	Syngenta	Contact	10% to 30% bloom	30
Switch	Syngenta	Systemic contact	10% to 20% bloom	7
Rovral	Bayer	Local systemic	10% bloom	No later than peak bloom
Cannonball	Syngenta	Contact	10% to 20% bloom	7
ProPulse	Bayer	Systemic	Preventative	14
Priaxor	BASF	Systemic	Prior to disease	21
Vertisan	DuPont	Local Systemic	Early bloom	21
Aproach	DuPont	Systemic	Early bloom preventative	14
Quash	Valent	Systemic	Prior to disease	21
Contans WG	SipcamAdvan	Biological	Soil applied	--

*100% bloom: one open flower on every plant
10% bloom: one open flower every tenth plant

Always read and follow manufactuer's label instructions.

Multiple applications on page 60

See pages 61-64 for fungicide rates

Timing: *Multiple* Application Program

Compound (Trade Name)	Mode of Action	Proper Timing	# Appls. Permitted
Topsin	Local systemic	First 10-30% bloom Second 4-7 days later	2-3
Endura	Local systemic	Early bloom Full bloom if needed	2
Proline	Systemic	25% bloom 5-14 days as needed	3
Omega	Contact	10-30% bloom 7-10 days later if needed	2-3
Switch	Systemic contact	10-20% bloom 7 days later if needed	2
Rovral	Local systemic	10% bloom 5-7 days later up to fb	2
Cannonball	Contact	10-20% bloom 7 days later if needed	<28 oz./yr.
ProPulse	Systemic	Early flower 7-14 day intervals	<16 oz./yr.
Priaxor	Systemic	Begin preventatively 7-14 day intervals	<20.5 oz./yr.
Vertisan	Local systemic	7-10 days after initial application at full bloom	<41 fl. oz./yr.
Aproach	Systemic	7-10 days after initial application at full bloom	<24 fl. oz./yr.
Quash	Systemic	7-10 days after initial application	8 oz./yr. max

FUNGICIDE GUIDE (foliar)

The following is a partial list of **foliar** applied chemicals now labeled (2-01-18) for disease control in edible beans in the Northarvest area. For a more complete list, including seed treatments and soil applied, refer to NDSU Extension Service Publication PP-622 "2018 ND Field Crop Plant Disease Management Guide".

Chemical	Dosage	Disease Control				Remarks
		Anthra-cnose	Rust	Halo Blight	White Mold	
***Bacillus subtillus* strain QST 713**						
Serenade ASO	2-6 qt/A		X		X	Monitor fields closely, spray when conditions warrant.
Coniothyrium						
Contans WG, 5.3%	1-2 lbs./A				X	Soil applied, consult agronomist
Boscalid						
Endura, 70%	8-11 oz/A				X	21 day PHI
Chlorothalonil						
Bravo WeatherStik, Echo, Echo 720, Chlorotholonil 720, Equus 720 SST 54%	1.38 - 2 pt/A	X	X			14 day PHI
Bravo Ultrex DG, Equus DF 82.5%	1.25 - 1.8 lb/A	X	X			
Echo Zn, BravoZn Terraanil Zn 38.5%	2-3 pt/A	X	X			Bravo Zn, Bravo 500 ZN, Echo Zn, Terranil Zn contain zinc
Echo 90 DF, 90%	1.13 - 1.63 lb/A	X	X			
Praiz 54% Vabro 54%	1 3/8-2.0 pt./A	X	X			
Copper						
Basicop WP 53%	2 - 4 lbs/A			X		Copper compounds, even though labeled, provide little or no control of halo blights.
Champ DP 57.6%	.66 - 2 lb/A			X		

Always read and follow fungicide application instructions.

FUNGICIDE GUIDE (Continued)

Chemical	Dosage	Disease Control				Remarks
		Anthra-cnose	Rust	Halo Blight	White Mold	
Champ Formula 2 Flowable 37.5%	.66 - 2 pt/A			X		Plant western grown seed.
ChampION++ 46.1%	.5 - 1.25 lb/A			X		
Cuprofix Ultra 40 Disprss 71.1%	.75-2 lbs/A			X		
Kocide 2000, 53.8%	.75 - 2.25 lb/A			X		
Kocide 3000, 46.1%	.5 - 1.25 lbs/A			X		
Kocide 4.5 LF, 37.5%	.66 - 2 pt/A			X		
MasterCop, 21.46%	.5 - 1.0 pt./A			X		
Badge X2, 45.31%	.5 - 1.25 lbs./A			X		
Badge SC, 32.17%	1 - 2 lbs./A			X		
Difenoconazole + Benzovindiflupyr						
Aprovia Top 11.25%; 7.50%	10.5 – 11 fl oz./A	X	X			Rotate fungicides for improved efficacy. PHI - 14 days.
Fludioxonil						
Cannonball WP 50%	7 fl oz/A				X	First Application at 10% to 20% bloom. PHI - 7 days.
Cyprodinil+Fludioxonil						
Switch 62.5 WG 37.6%:25.0%	11-14 oz/A				X	First application at 10%-20% bloom. Consider tank mix with Thiophonate methyl for improved control.
Fluazinam						
Omega 500F	.5 - .85 pts/A				X	First application 10 to 30% bloom. Coverage essential - use high volumes water. PHI - 30 days.

Always read and follow fungicide application instructions.

FUNGICIDE GUIDE (Continued)

Chemical	Dosage	Disease Control				Remarks
		Anthracnose	Rust	Halo Blight	White Mold	
Fluopyram+Prothioconzole						
ProPulse, 17.4%:17.4%	10.3 fl oz/A				X	Apply early bloom. Repeat 10-14 day intervals if needed. PHI 14 days.
Fluxapyroxad+Pyraclostrobin						
Priaxor 14.3%:28.6%	4-8 oz/A	X	X		X	Apply prior ro dsiease. See label. PHI 21 days
Iprodione						
Rovral 4F, 41.6% Nevado 4F 41.6% Meteor 41.6%	1.5 - 2.0 pt/A				X	10% bloom and peak bloom if neccessary
Penthiopkykrad						
Vertisan, 20.6%	14-20 fl. oz/A	X	X		X	Early bloom, 2nd app. full bloom. PHI 21 days.
Potassium Phosphite + Tebuconazole						
Viathon 49%; 3.3%	2.3 pt/A		X			Apply when weather is conducive for rust
Prothioconazole						
Proline 480 SC, 41%	5.7 fl oz/A		X		X	Apply at early bloom. Apply by ground with 20 or more gpa water. Consider multiple applications.
Metconazole						
Quash 50%	4.0 fl oz/A				X	Apply when conditions favor disease development and prior to infection. No more than 2 applications per year. PHI - 21 days.
Tebuconazole 38.7%						
Orius 3.6 F Tebuzol 3.6F Monsoon, Onset 3.6F Tebacure	4-6 fl oz/A		X			Do not apply more than 12 fl oz per year. See specific label for rates.

Always read and follow fungicide application instructions.

FUNGICIDE GUIDE (Continued)

Chemical	Dosage	Disease Control				Remarks
		Anthra-cnose	Rust	Halo Blight	White Mold	
Fluoxastrobin						
Evito 40.3%	2.0 - 4.75 fl oz/A	X	X			Do not apply more than 4.75 fl oz/A/season. PHI - 7 days
Qols						
Azoxystrobin						
Quadris 22.9%	6.0 fl oz/A for rust	X	X			Use alternate strobilurins during season to avoid resistance.
Satori 22.9%	6.0-15.5 fl oz/A					
Equation 22.9%	for other leaf diseases					
Tetraban 22.9%						
Azoxystrobin + Chlorothalonil						
Quadris Opti, 4.6%:46%	1.6-2.4 pt/A	X	X			
Azoxystrobin + Propiconazole						
Quilt 7%, 11%	14 fl. oz./A	X	X			14 day PHI
Picoxystrobin						
Aproach 22.5%	6-12 fl oz/A	X	X		X	Early bloom. Two applications max. 14 day PHI
Pyraclostrobin						
Headline EC 23.6%	6-9 oz/A	X	X			Apply prior to onset of disease. PHI 21 day. Maximum of 2 applications per season.
Headline SC 23.3%						
Sulfur						
Microthiol Disperss 80%	7 lb/A		X			

Always read and follow fungicide application instructions.

FUNGICIDE GUIDE (Continued)

Chemical	Dosage	Disease Control				Remarks
		Anthra-cnose	Rust	Halo Blight	White Mold	
Thiophanate-methyl						
Topsin M 70 WSB T-methyl 70 WSB	1.5-2.0 lb./A one application or	X			X	See "Disease Prevention & Control"
T-Methyl WSB-AG	1.0 - 1.5 lb/A two applications					Various formulations available
Topsin 4.5FL T-Methyl 4.5F	30-40 fl oz/A one application or 20-30 fl oz/A two applications	X			X	See specific label for complete directions.
Cercobin	32.7 - 43.6 fl. oz. or 21.8 - 32.7 fl. oz.	X			X	Rate dependent on number of applications, PHI - 28 days.
incognito 85WDG incognito 4.5F	0.8-1.6 lb/A 20-40 fl oz/A	X			X	Rate dependent upon number of applications

X = Product is labeled for crop and disease Source: NDSU Extension Service Bulletin PP-662: 2018 ND Field Crop Plant Disease Management Guide, other Corporate Fungicide Labels.

Always read and follow fungicide application instructions.

ESTIMATING CROP YIELDS

Estimating bean yield before harvest is difficult and often becomes more of an educated guess. The following method will give the producer some idea of what the crop will yield.

1. Estimate plant population (page 41)
2. Randomly sample 10 plants throughout field. The best way to do this is without looking, reach down and grab a plant, then count down three plants in either direction, using that plant as the sample. This reduces the risk of selecting the larger, more obvious plant.
3. Count the total number of beans (not pods), on these 10 plants.
4. Divide total from step 3 by 10, which gives average beans per plant.
5. Multiply plant population (step 1) by average beans per plant (step 4).
6. Divide this number by the average number of seeds per pound for the class being grown. This is usually 2500 for navies, 1250 for pintos. This will give pounds per acre yield.

Again, this is only a guide to estimating yield. Of course harvest loss would have to be deducted from the figure arrived at. To further insure accuracy, the entire procedure should be repeated several times in various parts of the field.

USING DESICCANTS

Although not always necessary, many growers routinely spray a maturing crop with a desiccant and report favorable results, especially when direct harvesting or trying to minimize the time cut beans need to remain on the ground before being threshed.

Several good desiccants are labeled: Drexel Defol 750, Gramoxone Inteon, Sharpen, and Valor for 2018. However, for any desiccant to perform properly certain environmental conditions need to exist. The crop must be drying down naturally; a plant that is still actively growing – or re-growing – will not respond as expected to a desiccant. Warm, sunny weather is required as well.

Applications should be made at least seven days before harvest. Apply when the crop is mature and at least 80% of the pods are yellowing and mostly ripe, with no more than 40% (bush type) or 30% (vine type) of leaves still green; research has shown applying desiccants too early can result in significant yield reductions. While a minimum of five gallons of water per acre (aerial) should be used, **large volumes of water – 20 gallons or more with ground applications - will give superior results.** Thorough coverage is the key. The use of MSO with Gramoxone, Sharpen and Valor will greatly enhance burn-down. Additionally, including 2 pounds of AMS to Gramoxone will further improve results. Two ounces of Valor or Sharpen, 1 to 2 pts. Gramoxone, 2 pounds AMS and 1% MSO as a tank-mix has proven very successful when weeds are present. See further rate information on the following page. As with all pesticides, follow label directions and pre-harvest interval.

Preharvest DEB Dessicant Quick Sheet 2018

Compound	Trade Name	Rate Per Acre	PHI	Remarks
Sodium chlorate	Drexel Defol 750	3.2 qts.	7 day	Salt
carfentrazone	Aim	1 – 6 fl. oz.	0 day	2 pt./ac. MSO
paraquat	Gramoxone Inteon	1.5-2.0 pts	7 day	.25-.5% NIS or 1% MSO
flumioxazine	Valor	2.0 fl. oz	5 day	2 pt./ac MSO If weeds present add 1-2 pts Gramoxone
saflufenacil	Sharpen	2.0 fl. oz	2 days	1 pt./ac MSO & 8.5 lbs. AMS/100 gal. No control of common lambsquarters
glyphosate*	various	Depending on product	7 day	**Not a desiccant!** Apply when beans <30% moist. Consult with ADM agronomist

* Use of glyphosate as a pre-harvest weed control measure is discouraged. Efficacy is limited, desired results are very slow, and superior compounds are now available. Make every effort to control weeds in early season when small and actively growing.

PREVENT CONTAMINATION

It is of the utmost importance that beans delivered to ADM are free of soybeans, corn, other contrasting classes of beans, or any other contaminants. Be very thorough when cleaning combines and truck boxes, so as not to allow other crops and classes of beans to become intermingled. An air compressor and shop vacuum cleaner can be very helpful. It can also be very worthwhile when changing classes to allow some beans to drop out into a secondary holding bin to be sure you will not contaminate your load.

SOYBEAN CONTAMINATION

Soybeans in particular pose an increasing threat to the dry bean industry. Once considered foreign matter and a nuisance in canned beans, soybeans are now viewed as an allergen with little or no tolerance at the canner level. In the past, dry beans contaminated with soybeans resulted in financial discounts; today with changes in end-user standards, loads contaminated with soybeans are routinely rejected. And while the traditional avenues of contamination still exist - soybeans remaining in the combine at harvest time or a few soys in the corner of a truck box - we now deal with an entirely new source: glyphosate resistant soybeans. When these plants volunteer in the following crop such as glyphosate resistantant corn they remain uncontrolled, regenerate, and once again volunteer in yet the following crop such as dry beans! Of course soybeans in a field of corn remain hidden and are nearly impossible to detect, yet this direct link to dry beans, when in the rotation, poses a very significant financial loss. The solution involves an awareness of the problem and a bit of detective work on the part of the grower. Herbicides active on glyphosate resistant soybeans in corn are available. In 2013, 14 and 15, growers experimented with post applications of Permit herbicide with very satisfactory results. Applications of .67 oz. DF Permit pre-flowering controlled up to 100% of volunteer soy plants. Strict rotational restrictions exist, particularly for

sugarbeets, potatoes, canola and sunflowers. Contact your ADM agronomist for further discussion.

WHEN TO HARVEST

Weather conditions will play a major role in harvesting your edible bean crop. Although not easy to do, it is optimal to harvest navy beans at 17 to 18 percent moisture, while pinto and black beans should be harvested at 15 to 16 percent moisture. This will hold splitting and seedcoat damage to a minimum. Harvesting at lower moisture levels may result in an excessive percentage of split beans and checked seedcoats. Beans with checked seedcoats may split with further handling.

COMBINE OPERATION

Use only enough cylinder speed to do a good job threshing (150 to 300 rpm). It is usually desirable to reduce cylinder speed as the day progresses to compensate for additional drying. Maintain as great a cylinder speed and cylinder concave clearance as possible, while still doing a good job of threshing. Check the operator's manual for recommended cylinder speed and cylinder concave setting. Manufactures' recommendations apply to an average of normal operating conditions. It may be necessary to harvest only in the morning and evening when pods are tough, in order to hold shattering losses to a minimum, and to reduce the number of split beans and checked seedcoats. Crowd the combine cylinder to near maximum capacity without over-loading. This may be accomplished by using a faster ground speed, or by placing more rows in a windrow. The additional straw going through the threshing mechanism will help cushion the beans and prevent damage. NOTE: Dry bean growers should analyze beans frequently for cracked seedcoats during the harvest process. Remember, highly checked beans can result in monetary reductions.

Open the adjustable chaffer sufficiently for all threshed beans and some hulls to fall through to the cleaning sieve. Open the chaffer extension slightly wider to permit beans in the pods to go through and into the tailings auger. Open the adjustable sieve only enough to let completely threshed beans fall through to the clean grain auger. Use a relatively strong fan blast and direct the blast towards the forward one-third of the cleaning shoe. Consult the operator's manual for specific recommendations and proper operation of equipment.

Check the tailings return periodically to note the quantity and composition of the material being returned to the cylinder for rethreshing, any appreciable quantity of threshed beans in the tailing return indicates that the adjustable sieve or possibly the adjustable chaffer are too tightly closed. Completely threshed beans returning through the tailings auger for rethreshing will increase the possibility of split beans and checked seedcoats.

Monitor the hopper for dirt and foreign materials and for beans that are split or have checked seedcoats. Excess dirt and chaff generally indicate that the sieve is adjusted too wide or that the fan blast is inadequate or improperly directed. Excessive checks and splits generally indicate one or more of the following.

- Cylinder speed is too high.
- Cylinder concave clearance is too small
- Too many concave bars or grates are being used.
- Too many completely threshed beans are being returned through the tailings system.
- Beans are physically too dry

Always handle beans carefully. Avoid dropping beans from great heights during unloading and handling. Beans check and crack when dropped, particularly on hard surfaces. Cushion or deflect fall of beans whenever possible. Keep elevator flighting chains snug so flights ride true in housing.

CHECKING FOR HARVEST LOSSES

To check your field for harvest losses, mark off a one foot wide strip across the swath of the combine, count the number of beans in each square foot, and obtain an average. Refer to the chart below and make adjustments if necessary.

Beans per square foot	Navy & Black Beans lbs/acre lost	Pinto Beans lbs/acre lost
4		133
6	100	200
8	133	267
10	167	333
12	200	400
14	233	467
16	267	533
18	300	600
20	333	667
22	367	733
24	400	800
26	433	867

FOOD SAFETY

Consumers are continually placing more demands on the food safety industry to provide a healthy, nutritious, wholesome, and safe food supply - **Food Safety** is no doubt a term you are hearing more frequently. Food Safety is the responsibility of everyone involved with getting food from the **"field to the fork."** Our focus will be on the prevention of contamination and record keeping. Three hazards that we need to be concerned about are microbiological, physical, and chemical.

Microbiological: Stored beans need to be monitored for appropriate storage conditions, with an emphasis on condition of the storage building and conditions. Prevention of conditions that could promote mold growth is essential.

Physical: Doing our part to reduce the physical hazards associated with the production of dry beans. Glass, stones, and metal may not be able to be eliminated in the production process, but being aware of these hazards can reduce the incidence of contamination.

Chemical: Make sure that you are following recommended chemical applications, used in the labeled amounts as required.

Allergens: True food allergies affect a relatively small percentage of people nationwide. Food intolerances, as well as the consumer's false associations between food and illness, are much more common than actual allergic reactions. Nonetheless, adverse physical reactions to food are of growing concern to both consumers and to food product manufacturers. Liability and recall issues, as well as recent changes to labeling laws, have had a significant impact on the way food manufacturers develop and process their products. This will continue to put pressure on us (ADM EBS and you the producer) to reduce the risk of allergens reaching the consumer. **The main issue for us is soybeans. Crop rotations, certified seed, and cleaning of harvesting and hauling equipment will be essential.**

Traceability: For a system to provide a **"field to fork"** history we must be capable of providing the customer with traceability logs. Field production records and facility processing logs are becoming the industry standard.

ADM Edible Bean Specialties, Inc. is committed to providing a safe food supply. This production guide is one step toward producing high quality, nutritious, and safe beans for the consumer.

Thank you for your assistance and participation in this important task.

NUTRITIONAL PROFILE OF EDIBLE BEANS

Cooked beans are an excellent food. They contain protein, iron, and magnesium. One cup of cooked beans provides a good source of zinc, copper, and manganese. They are high in fiber and a good source of potassium. They are very low in sodium, fat, and are cholesterol free. In regards to calories, they are equivalent to a 7 ounce baked potato.

Summary of one cup cooked dry beans
(average of 8 classes)

Nutrient	Amount		% USRDA
Protein	16.0	grams	
Iron	5.4	mg	30
Magnesium	92.0	mg	23
Zinc	2.1	mg	14
Copper	0.5	mg	
Manganese	1.0	mg	
Fiber	12.0	grams	48
Potassium	620.0	mg	18
Cholesterol	0	mg	
Sodium	8.0	mg	
Fat	1.6	grams	

FURTHER DRY BEAN RESOURCES

North Dakota State University
www.ext.nodak.edu/

Entomology	701-231-7582
Plant Pathology	701-231-8362
Plant Diagnostic	701-231-7854
Agronomy	701-231-7125
Soil Science	701-231-8901

University of Minnesota St. Paul
www.extension.umn.edu

Agronomy	612-625-8700
Entomology	612-624-3636
Plant Pathology	612-625-8200
Plant Disease Clinic	612-625-1275
Soil Water & Climate	612-625-1244

Northarvest Bean Growers Association
218-334-6351 www.northarvestbean.org/

US Bean Dry Council
360-277-0112 www.usdrybeans.com/

USDA National Agricultural Statistics Service
http://www.nass.usda.gov

USDA National Agricultural Statistics Service: Reports by calendar
http://www.nass.usda.gov/Publications/Reports_By_Date/index.asp

U.S. registered pesticide labels
http://www.cdms.net/LabelsMsds/LMDefault.aspx

North Dakota Dept of Agriculture registered pesticide database
http://www.kellysolutions.com/nd/

FURTHER DRY BEAN RESOURCES
Continued

Bean Improvement Cooperative (BIC)
www.css.msu.edu/bic/

P**est Information Platform For Education & Extension (PIPE)**
http://legume.ipmpipe.org/cgi-bin/sbr/public.cgi

Colorado State University Dry Bean Portal
www.colostate.edu/Orgs/VegNet/vegnet/beans.html

NOTICE:
These statements are not intended to replace or supersede the manufacturers' labels, directions and guidelines. You should read and follow the manufacturers' labels, directions and warnings when using any product. ADM Edible Bean Specialties, Inc. and its affiliates ("ADM") make no warranties with respect to any of the products identified in this booklet and ADM does not make any guarantees to results, performances, crop yield and price with respect to any recommendations or advice provided. Actual crop yield and quality are dependent upon many factors beyond ADM's control.

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BAKED NAVY BEANS

2 lb. navy beans
1 lb. bacon, cut into small pieces
1 ¼ cup brown sugar
1/3 cup molasses
1 T. prepared mustard
1 medium onion chopped
Salt & pepper

Soak beans all day or overnight in enough water to cover. Drain and add all ingredients to slow cooker and cook all day and overnight.

Tip: Do not stir beans or they will become mushy.

Michelle Jensen

Chipotle Black Bean Soup

Ingredients:
8 cups cooked black beans
2- 10 oz. can diced tomatoes & green chilies
4- 6 cups vegetable stock
2 large onions, diced
1 - 7 oz. can chipotles in adobo sauce
4 cloves of garlic, minced
1 T. cumin
2 T. Chili powder
¼ cup lime juice
Olive oil to sauté vegetables
Salt and pepper to taste

Assembly:
In a skillet, sauté onions, garlic, and chipotles until the onions are cooked through. Put black beans, diced tomatoes & chilies, sautéed vegetables, lime juice, and the sauce from the chipotle can in a crock pot and mix well. Add vegetable stock 1 cup at a time and stir to incorporate. Add stock until the soup is the consistency you want.

You can mash some of the beans to thicken the soup or transfer to a blender in batches and blend if you want it to be less chunky.

Top with sour cream, diced tomatoes, avocado, cilantro, lime juice, and chips.

Kathleen Spencer

MICROWAVED PINTO FUDGE

3-4 dozen
1 can (15 oz) pinto beans, rinsed and drained
1 cup baking cocoa
¾ cup butter, melted
1 tsp vanilla
7½ cups powdered sugar
½ cup chopped walnuts

Mash beans with fork until smooth. Cover and heat in microwave about 1 minute, or until warm. Add cocoa, melted butter, and vanilla to the beans. Slowly mix in the powdered sugar and walnuts. Coat an 8x8 pan with nonstick spray, and then press bean mixture into pan. Cover and refrigerate until firm. Cut into 1x1 pieces.

Nanette Rayapati

RAJMA (KIDNEY BEAN CURRY)

2 cans (15 oz each) kidney beans, rinsed and drained
4 tbsp butter
1 med. Onion, chopped
½ tsp garlic powder
½ tsp ginger powder
1 tsp cumin powder
½ tsp cinnamon
¼-½ tsp cayenne pepper
½ tsp turmeric
1 can (15 oz) crushed or diced tomatoes
1 cup frozen peas, optional
1-2 tsp salt
White rice, cooked

Melt the butter in a pan over medium heat. Saute the chopped onion, and then add the spices: garlic, ginger, and cumin powders; cinnamon, cayenne and turmeric. Stir onions and spices for a few minutes. Add the kidney beans, tomatoes, peas if desired, and 1 cup water. Simmer for 15-20 minutes, or until beans and peas are warmed through. Add salt to taste. Serve over white rice.

Nanette Rayapati

FEIJOADA (BRAZILIAN BLACK BEANS)

2 cans (15 oz each) black beans
1 lb ham; on bone is preferred, but if boneless, cube the ham
1 lb smoked sausage, cut into 3 inch slices
2 tbs vegetable oil
2 bay leaves
1 onion, chopped
2 cloves garlic, minced
Salt to taste
White rice, cooked
Salsa for topping
2-3 oranges, washed and quartered

Place ham with bone in a large pot with 1 cup water. Bring to a boil, and simmer over medium heat for 45-60 minutes or until the meat begins to come off the bone (only 15 minutes cook time if using ham cubes). Add the smoked sausage for the last 15 minutes of cook time. Next, add the black beans, oil, bay leaves, onion, and garlic. Heat the bean and meat mixure for 15-20 minutes, and then salt to taste. Serve the feijoada black beans over rice, and then top with salsa; squeeze one or two orange quarters over the feijoada before eating.

Nanette Rayapati

WHITE CHICKEN CHILI

1 tablespoon olive oil
1 pound boneless chicken breasts, cut into 1/2 - 3/4 inch cubes
3 cloves garlic, minced
1 onion, chopped
1 4-ounce can chopped green chilies
2 14.5-ounce cans chicken broth
2 teaspoons ground cumin
2 teaspoons dried oregano leaves
1/8 teaspoon cayenne pepper
3/4 cup frozen petite white corn
1 can Bush's navy or great northern beans
2 tablespoons chopped cilantro

Heat olive oil in skillet, add chicken, garlic and onion, heat until chicken is browned. Stir in chopped chilies, broth, cumin, oregano and cayenne. Bring to a boil and simmer for 15 minutes. Add corn, beans, and cilantro. Simmer another 15 minutes. Top with Monterey Jack cheese if desired.

HAM AND BEAN SOUP

A recipe for ham bean soup with Navy or Great Northern beans and chopped vegetables.

INGREDIENTS:
* 8 cups water
* 1 pound navy beans, or great northern beans
* 2 cups cubed ham
* 1 ham bone or ham hock, optional*
* 1/2 cup chopped onion
* 1/4 teaspoon pepper, or to taste
* 1-2 carrots, chopped
* 1-2 ribs celery, chopped, or sliced thinly
* 1/2 teaspoon Lowry salt, or to taste
* 2 medium potatoes - cubed

PREPARATION:
Add beans and water, bring to boil.
Stir in ham, ham bone or hock, pepper, carrot, potato, and celery. Bring to a boil; reduce heat, cover, and simmer until beans are tender (skim foam from top), about 1 1/2 to 2 hours.

If soup is too thick, add a little water.
*Remove ham bone or ham hock and trim meat from bone. Return meat to soup; Simmer for about 15 minutes longer. Ham and bean soup serves 6.

Roger Hoffman

OLD FASHIONED BAKED BEANS

Next time you feel like baking a pot of beans, why not make a big batch and freeze the extra for future use? They freeze and reheat beautifully and it takes little more effort to do 6 quarts than 6 cups. Here are instructions for each quantity:

For 1½ qts. (6 servings)	For 6 qts. (24 servings)
1 lb. great northern, small white or navy beans	4 lbs.
1 qt. boiling water	4 qts.
1½ tsp. salt	2 Tbsp.
1 tsp. dry mustard	4 tsp.
½ tsp. fresh ground black pepper	2 tsp.
Dash of cayenne or Tobasco	¼ tsp.
½ cup chopped onion	2 cups
¼ cup molasses or honey	1 cup
¼ cup brown sugar	1 cup
¼ cup cider vinegar	1 cup
¼ lb. salt pork, cubed	1 lb.

Add beans to boiling water; boil 2 minutes, then remove from heat and let soak 1 hour, or cold-soak overnight. Drain beans. Combine dry ingredients and mix with beans. Stir in onion, molasses, brown sugar and vinegar. Pour half of the 6-cup mixture into a 1½ qt. or 2-qt. baking dish or bean pot. (A big roasting pan works well for the 6-qt. amount.) Add half the pork, then rest of beans. Top with remaining pork. Pour in boiling water to top of beans. Cover. Bake at 300º for 6 hours if to be served at once: 5 hours for those to be frozen. Add a little boiling water if needed during baking.

CALICO BEANS

½ lb. bacon, cut into 1" pieces
2 tablespoons bacon drippings
1 lb. ground beef
1 onion, chopped
¾ cup brown sugar
½ cup chili sauce
2 tablespoons vinegar
1 teaspoon dry mustard
2 cans (16 oz. each) pork and beans
2 cups cooked or 1 can kidney beans
2 cups cooked or 1 can lima beans
2 cups cooked or 1 can navy beans
2 cups cooked or 1 can butter beans
2 cups cooked or 1 can pinto beans

Fry bacon in skillet until crisp. Remove bacon and discard all but 2 tablespoons drippings. Brown beef and onion in drippings. Drain beans, except pork and beans, and combine all ingredients. Bake, covered at 350º F for 45 minutes. Serves 12-14.

SPICY ZUCCHINI BREAD

1 cup mashed, cooked pinto beans
3 eggs
1½ cups sugar
1 cup vegetable oil
1½ cups shredded zucchini
1 teaspoon vanilla extract
2 cups sifted flour
1 teaspoon salt
1 teaspoon baking soda
2½ teaspoons baking powder
2 teaspoons ground cinnamon

Mash cooked pint beans using mixer, blender, potato masher or fork. Grease two 9”x5” loaf pans. Preheat oven to 350º F. In a large bowl, combine eggs, sugar and oil. Beat with an electric mixer until smooth. Add zucchini, beans and vanilla. Sift together flour, salt, baking soda, baking powder and cinnamon. Add to bean mixture. Stir until blended. Pour into greased pans. Bake 40 to 50 minutes or until a wooden pick inserted in center comes out clean. Remove from pan. Cool on a rack. May be stored in an air-tight plastic bag at room temperature or in the refrigerator. Makes 2 loaves.

Variation: Spicy Carrot Bread - Substitute 1 cup shredded carrot for 1½ cups shredded zucchini.

CHILI BEAN SOUP

1 lb. pink, red, or pinto beans
6 to 8 cups boiling water
1 tsp. garlic
1 tsp. onion salt
¼ tsp. each thyme and marjoram
1 can (10½ oz.) beef or chicken broth
1 can (16 oz.) stewed tomatoes
1 package (1⅜ oz.) chili seasoning mix or 1 can (7 to 10 oz) green chili salsa

Rinse, sort and soak beans. Drain and empty them into a large pot. Add boiling water, garlic and onion salt, thyme, and marjoram. Cover and simmer until beans are tender (2½ to 3 hours). Don't let beans boil dry. Add hot water as needed. Spoon out 3 cups of the cooked beans to use another day in another way. Mash rest of beans with their liquid. Add remaining ingredients, plus 1 cup hot water. Heat at least ten minutes to blend flavors. **Makes 5 to 6 cups zippy soup.** P.S. Those spooned-out beans make a great salad. Just cool them, cover with French dressing and refrigerate until needed.

BUCKAROO BEANS

For 6 substantial servings, you will need:

2 cups Idaho pinto or red beans
6 cups water
1 large onion, sliced thick
2 fat cloves garlic, sliced thin
1 small whole bayleaf
½ lb. ham, slab bacon or salt pork
2 cups canned tomatoes
½ cup chopped sweet red or green pepper
2 tsp. chili powder
2 tablespoons brown sugar
½ tsp. powdered mustard
¼ tsp. oregano or cumin
salt to taste

Place heavy kettle with soaked beans and soaking water over high heat. Add onion, garlic, bayleaf, meat. Smoked ham should be cut in ½ inch cubes; slab bacon or salt pork (salt washed off) sliced through twice each way not quite to the rind. Bring to boiling point rapidly. Reduce heat to simmer. Cover tightly. Cook 1½ hours. Add remaining ingredients, except salt. Bring to boiling point rapidly, reduce heat to simmer. Taste for salt. Cover. Simmer 2 hours. There should be enough liquid left on beans to resemble a medium-thick gravy.

Compliments of…
Idaho Bean Commission
P.O. Box 9433 • Boise, Idaho 83707

BRAISED SHORT RIBS AND BEANS

4 lbs. beef short ribs
2 teaspoons salt
½ teaspoon pepper
½ teaspoon dried leaf oregano
½ teaspoon dried leaf basil
2 tablespoons chili powder
2 to 4 tablespoons vegetable oil
1 large onion, sliced
2 garlic cloves, minced
2 cups red wine
2 (15 oz) cans or 3½ cups cooked, dark red kidney beans, drained

Preheat oven to 350º. Trim excess fat from ribs. In a small bowl, combine salt, pepper, oregano, basil and chili powder. Mix well. Rub seasonings into ribs, covering all sides. Heat 2 tablespoons oil in a medium skillet. Brown ribs in oil until golden brown on all sides. Remove ribs and set aside. Add remaining oil if needed. Sauté onion and garlic in oil until onion softens. Cover bottom of a shallow 4 qt. casserole with onion mixture. Place ribs on top of onion. Pour in wine. Cover and bake until ribs are fork tender, 1½ to 2 hours. Add beans. Cover and bake 30 minutes longer. Remove ribs to platter. Stir beans into pan juices before placing around ribs.

Red River Edible Bean Growers Association

DILLED BEAN BREAD

1 cup bean purée made with pinto beans*
2 tablespoons margarine
2 tablespoons minced onion
1 teaspoon salt
2 teaspoons dried dill weed
12 pkg. active dry yeast
1 cup lukewarm water
2 tablespoons sugar
3½ to 4 cups all-purpose flour
1 egg, slightly beaten
½ tablespoon coarse salt
2 tablespoons grated Parmesan cheese
1 tablespoon chopped parsley

***Bean Purée**
1 cup dried pinto beans
water for soaking
2½ cups water
1 teaspoon salt
1 tablespoon vegetable oil

Soak beans overnight. In saucepan, combine drained soaked beans, 2½ cups water, salt and oil. Bring to a boil; reduce heat. Cover and simmer until beans are tender, 1 to 1½ hours. Drain beans, reserving cooking liquid. Put 1 to 2 cups beans in blender with ¼ to ½ cup reserved liquid. Blend on medium speed until smooth. Makes about 2 cups of purée.

Melt margarine in a medium skillet. Sauté onion in skillet until tender but not browned. Stir in bean purée, salt and dill weed. Mix well. Remove from heat and cool to lukewarm. In large bowl, dissolve yeast in lukewarm water. Stir in sugar. Add cooled bean mixture to yeast mixture. Stir in flour to make a stiff dough. Turn dough onto a lightly floured surface and knead until smooth and elastic. Return dough to bowl. Lightly butter top of dough and let rise until doubled in bulk. Punch down dough and shape into a loaf. Place in greased loaf pan (9"x5"). With a sharp knife, make several diagonal slashes about ¼" deep in top of loaf. Brush top of loaf with beaten egg. Combine salt, cheese and parsley in a small bowl. Sprinkle over loaf. Cover and let rise until doubled in bulk, 30 to 45 minutes. Preheat oven to 375º F. Bake until loaf is golden brown and sounds hollow when tapped, 30 to 40 minutes. Remove from pan. Cool on a rack. May be stored in an airtight plastic bag at room temperature or in the refrigerator. Makes 1 loaf.

Dilled Bean Bread contains 50% more iron and protein than conventional white bread.

Northarvest Edible Bean Growers Association

MEATLESS TAMALE PIE

Although tamale pie is traditionally made with beef, this one, based on a recipe from Sharon Cadwallader's Complete Cookbook, is made with beans and, to my taste, is just as delicious, not to mention less expensive.

PREPARATION TIP: Since green olives are salty, I prepare the beans without any salt and do not otherwise add salt to the filling. If you are on a strict low-sodium diet, leave out the olives as well. You could probably also skip the salt in the crust, since both the cheese and the chilies contain salt. The filling can be prepared in advance, with the batter added when you are ready to bake it.

FILLING

1 small onion, chopped (⅓ cup)
2 cloves garlic, minced
1 cup finely chopped green pepper (2 medium)
1 tablespoon oil
2 tablespoons tomato paste
1 heaping teaspoon chili powder
½ cup water
3 cups cooked, mashed beans (kidney, pinto or pink)
¼ cup sliced green olives (with or without pimento)
3 tablespoons minced fresh parsley
Freshly ground black pepper to taste

CRUST
1 cup yellow corn meal, preferably stone-ground
1 tablespoon flour
¼ teaspoon salt, if desired
1½ teaspoons baking powder
1 egg, lightly beaten
½ cup skim or low-fat milk
2 tablespoons oil
2 tablespoons chopped green chilies, or more, to taste

TOPPING
½ cup grated sharp Cheddar

1. Sauté the onions, garlic, and green pepper in the oil in a large, nonstick skillet until the vegetables are softened (you may cover the skillet for a few minutes.

2. Stir in the tomato paste and chili powder, then add the water, beans, olives, parsley, and pepper. Simmer the mixture, stirring it, until it is heated through.

3. Grease an 8-inch baking dish or shallow casserole and spread the bean mixture in it evenly.

4. In a medium bowl, combine the corn meal, flour, salt, and baking powder. Add the egg, milk, oil, and green chilies, and stir the mixture just to combine the ingredients.

5. Spread the batter over the bean mixture, top with the cheese, and bake the pie, uncovered, at 400º for 20 minutes or until the dough rises and is golden brown.

USEFUL INFORMATION

To find the diameter of a circle, multiply the circumference by .31831.

To find the circumference of a circle, multiply the diameter by 3.1416.

To find the area of a circle, multiply the square of the diameter by .7854.

To find the surface of a ball, multiply the square of the diameter by 3.1416.

To find the side of a square equal in area to a given circle, multiply the diameter of the circle by .8862.

The find the cubic inches in a ball, multiply the cube of the diameter by .5236.

Doubling the diameter of a pipe increases its capacity four times.

Double riveting is from 16 to 20 percent stronger than single.

One cubic foot of anthracite coal weighs about 53 pounds.

One cubic foot of bituminous coal weighs from 47 to 50 pounds.

One ton of coal is equivalent to two cords of wood for steam purposes.

A gallon of water (U.S. Standard) weighs 8⅓ lbs. and contains 231 cubic inches.

There are nine square feet of heating surface to each square foot of grate surface.

A cubic foot of water contains 7½ gallons, 1,728 cubic inches and weighs 62½ lbs.

Each nominal horse power of a boiler requires 30 to 35 pounds of water per hour.

A horse power is equivalent to raising 33,000 lbs. one foot per min., or 550 lbs. one ft. per second.

1 horse power equals 42.41 BTU per minute.

To find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by .434.

Lbs. per cubic foot x 1.2445 equals lbs. per bushel.

To measure ground speed of any machine, walk alongside for 20 seconds, counting your three foot steps, and divide by 10. This equals speed in mph.

16.5 ft. = 1 rod

43,560 sq. ft. = 1 acre

METRIC CONVERSIONS

One Inch	=	2.5 Centimeters
One Foot	=	30.0 Centimeters
One Yard	=	.9 Meters
One Mile	=	1.6 Kilometers
One Acre	=	.4 Hectares
One Ounce	=	28.0 Grams
One Pound	=	.45 Kilograms
One Ton	=	.9 Tonnes
One Pint	=	.45 Liters
One Quart	=	.95 Liters
One Gallon	=	3.8 Liters

Area of circle = radius squared x 3.1416; or diameter squared x 0.7854.

Area of rectangle or square = length x width.

Area of right triangle = length x width ÷ 2.

Area of other triangle = base x height a right angle to base ÷ 2 (see diagram).

Volume of cube or rectangular box is length x width x height.

Volume of cylinder is radius squared x 3.1416 x length of cylinder.

Volume of cone is radius squared x 1.0472 x height. (e.g. round hopper bottom)

Volume of pyramid is area of base x 1/3 the height. (e.g. square hopper bottom)

FACTS AND FIGURES
METRIC CONVERSION

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
in	inches	2.54	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m2)	2.47	acres	
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (WEIGHT)		
g	grams	0.035	ounce	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1,000 kg)	131	short tons	
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 lbs)	0.9	tonnes	t

FACTS AND FIGURES
METRIC CONVERSION

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons (U.S.)	gal
l	liters	0.22	gallons (Imp)	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
tsp	teaspoons	5	milliliters	ml
tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons (U.S.)	3.8	liters	l
gal	gallons (Imp)	4.5	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (EXACT)		
ºC	Celsius Temp.	(ºC x 9/5) +32	Fahrenheit Temp	ºF
		TEMPERATURE (EXACT) TO METRIC		
ºF	Fahrenheit Temp	(ºF - 32) x 5/9	Celsius Temp	ºC

Grower Production Record (Pinto)

ADM

Field Description	Variety	Herbicides (pre, post, desiccants)	Rate/Date	Fungicides	Rate/Date	Insecticide	Rate/Date
Field #1							
Field #2							
Field #3							
Field #4							

Grower Production Record (Navy)

ADM

Field Description	Variety	Herbicides (pre, post, desiccants)	Rate/Date	Fungicides	Rate/Date	Insecticide	Rate/Date
Field #1							
Field #2							
Field #3							
Field #4							

2018

JANUARY

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

FEBRUARY

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

MARCH

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

APRIL

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

MAY

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

JUNE

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

JULY

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

AUGUST

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

SEPTEMBER

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23/30	24	25	26	27	28	29

OCTOBER

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

NOVEMBER

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

DECEMBER

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23/30	24/31	25	26	27	28	29

2019

JANUARY

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

FEBRUARY

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

MARCH

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24/31	25	26	27	28	29	30

APRIL

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

MAY

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

JUNE

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23/30	24	25	26	27	28	29

JULY

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

AUGUST

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

SEPTEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

OCTOBER

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

NOVEMBER

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

DECEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

SOUND PRODUCTION PRACTICES

SATISFYING RESULTS