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S. Tuwafe

A. Boe

A. L. Kahler

R. L. Wynia

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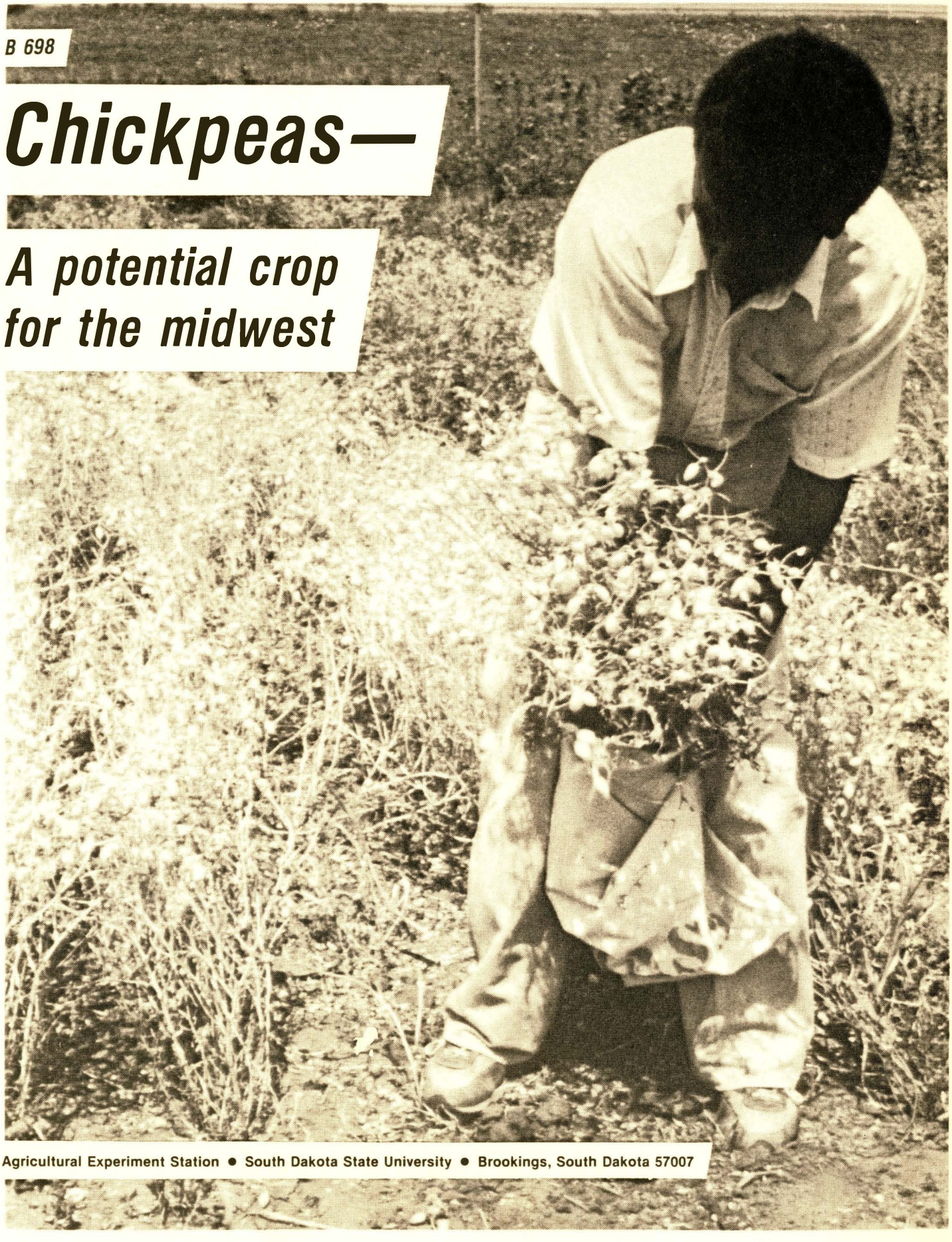

Agricultural Experiment Station • South Dakota State University • Brookings, South Dakota 57007

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Chickpeas—A potential crop for the midwest

S. Tuwafe, graduate research assistant; **A. Boe,** assistant professor;
A.L. Kahler, research geneticist and adjunct associate professor; and
R.L. Wynia, assistant in; Plant Science Department, SDSU

Chickpea, also known as the garbanzo bean, will grow in South Dakota. In fact, it often needs our droughty weather to reach maturity.

While it wouldn't take many garbanzo beans to satisfy the South Dakota salad bar market, studies have shown that chickpeas can be fed to swine without cooking.

The "unknown" in the potential chickpea industry is marketing. We will need more research into marketing and on feeding livestock an energy-rich, high protein chickpea supplement.

Chickpea (Cicer arietinum L.) is an annual legume. It is widely grown in Africa, Asia, the Mediterranean, the Far and Middle East, Central and South America, and Mexico for its edible seed. Chickpea is the third most important pulse (grain legume) crop in the world with total production exceeded only by dry beans and peas.

India grows almost 90% of the world's production, which in 1982 was 6.2 million metric tons from 22.44 million acres (FAO 1983). In the United States, large-seeded (Kabuli) types are used primarily in the salad bar market, with most produced in coastal areas of central California (approximately 8000 acres annually).

Plant Description

Chickpeas are 8 to 40 inches tall (erect to prostrate), branching, gray-green annuals with glandular, hairy, pinnately compound leaves (Fig 1). Plants have one to three white, pink, purplish, or blue self-pollinated pea-like flowers per raceme. Pods are 3/8 to 7/8 inch long and generally contain one or two seeds.

Depending upon type, seeds are cream, yellow, brown, black, or green, and more or less rounded with smooth or wrinkled coats. Kabuli seed types are medium to large, rounded, and cream colored. Desi types are small to medium in size, variously colored and shaped. They account for approximately 90% of the world's production (Meuhlbauer et al, 1982) (Fig 2).

Seedling emergence is similar to that in peas and grasses, with cotyledons remaining at planting depth. If young plants are damaged by grazing, insects, freezing, hail, or wind, new shoots can originate from protected buds below ground level.

Nutritional Value

Pulses are one of the most important sources of nutrients, especially protein, for people throughout the world (Table 1).

Although chickpeas contain less protein than soybeans and some other pulses, they have been successfully fed to swine without cooking. Chickpeas are a good source of lysine but are relatively low in methionine and cystine.

On 16% protein diets where chickpeas replaced up to 88.8% of a corn and soybean meal mixture, pigs performed as well as those fed the control diet (Pond and Maner,1984).

Gonzalez et al (1960) compared the nutritive value of a large, white-seeded variety used for human food with that of a small-seeded variety used mostly for

Table 1. Contents of whole chickpea seed per 100 grams.*

Oil	4.6%
Calories	362/100 g seed
Moisture	4.5-15.6%
Protein	14.9-24.6 g
Fat	0.8-6.4 g
Carbohydrate	63.5%
Fiber	2.1-11.7 g
Ash	2.0-4.8 mg
Ca	140-440 mg
P	190-382 mg
Fe	5.0-23.9 mg
B carotene equiv	0-275 mg
Thiamine	0.21-1.10 mg
Riboflavin	0.12-0.33 mg
Niacin	1.3-2.9 mg

*Duke (1981).

feeding swine in the central valleys of Mexico. They found the large-seeded variety to be slightly higher in protein (22%, as opposed to 20% for the small-seeded variety) but substantially lower in crude fiber.

Compared to broadbeans and lentils, the other two major legumes consumed by Middle East inhabitants, chickpeas were the most suitable for protein-rich food for infants and children (Tannous et al, 1965).

Uncooked legume seeds often contain anti-nutritional factors, such as hemoglutinon and antitrypsin, that can be toxic if consumed in large quantities. Although reports of antitrypsin activity have been made for chickpeas, we are not aware of any toxicity in raw seeds fed to livestock.

Growing Chickpeas

Temperature, Moisture. Chickpeas are a spring or summer crop in South Dakota, although they are a "winter" crop in the tropics. They are adapted primarily to low rainfall regions, but yield well under irrigation on well drained soils.

In South Dakota there is enough residual soil moisture in land that was summer fallowed for a chickpea crop; it will require only average or slighly below average precipitation during the growing season. In 1982-84 evaluations at Brookings, Highmore, Rapid City, and Wall, irrigation was not required for high yields. Drought during August actually facilitated maturity.

Excessive rainfall and high humidity, especially after initial flowering, can cause excessive vegetative growth, continuous flowering, and delayed maturity. Montana test plots that were irrigated in above-normal rainfall years lodged more and produced 30% less seeds (Baldridge et al, 1982).

Seeding. Chickpeas can be planted in South Dakota from early to mid spring, depending on soil type, temperature, and available moisture. Late May and early June plantings at Brookings (in 1981 and 1984) flowered continuously and matured late, reducing seed yield. The same seed sources planted in early May (1982) matured properly and produced excellent yields.

More research is needed on planting date in South Dakota, but because chickpeas are quite frost tolerant, it is best to plant soon after soil temperatures have reached 43°F at planting depth.

Seeding depth can vary from 3 to 6 inches, depending on available moisture. Seeds should be treated with a fungicide to prevent damping off of seedlings caused by soil-borne fungi. Seeds with cracked coats are susceptible to soil-borne pathogens, and the resulting damaged embryos have a poor germination rate. Seeds must be handled gently during planting.

A Highmore trial showed that yields increased as row spacing decreased from 36 to 6 inches with a consistent seeding rate of 2 to 3 seeds per linear foot of row (Table 2).

Fertilizers. Information on fertilizer effect is very limited. Seed that is properly inoculated with Rhizobium needs no supplemental nitrogen fertilizer. When a soil test indicates that levels of phosphorus, potassium, or other nutrients are low, fertilize according to recommendations for dry beans, since specific recommendations for chickpeas in South Dakota are not available at this time.

Weed Control. The EPA has included chickpeas in the crop category "beans," allowing us to use pesticides which are registered on beans, field beans, or dry beans.

Before applying any herbicide registered for beans, consult the product label for specific recommendations for chickpeas.

Harvesting. Chickpeas can be direct-combined or swathed, but seeds must contain less than 12% moisture for safe storage. Cylinder speed and concave clearance must be watched closely to prevent seed cracking or breakage (Baldridge et al, 1982).

Performance Trials, Other States

Trials of large-seeded commercial cultivars in Idaho (Auld et al, 1982), Montana (Baldridge et al, 1982), and Washington (Meuhlbauer et al, 1982) show that the cultivars Spanish Common, UC-5, and Mission are fairly well adapted to those regions. Seed yields in those trials generally ranged from 1200 to 3500 lb/acre.

The Idaho Agricultural Experiment Station recently released two cultivars (Aztec and Lyons) for growers interested in producing seed for export markets (Auld et al, 1985).

Fig 1. Young chickpea plants in a trial at Brookings in 1982.

Table 2. Mean seed yields for SDG16 planted in four different row spacings at Highmore in 1984.

Row width	Seed yield
Inches	lb/acre
6	2936
12	2674
24	2135
36	1900

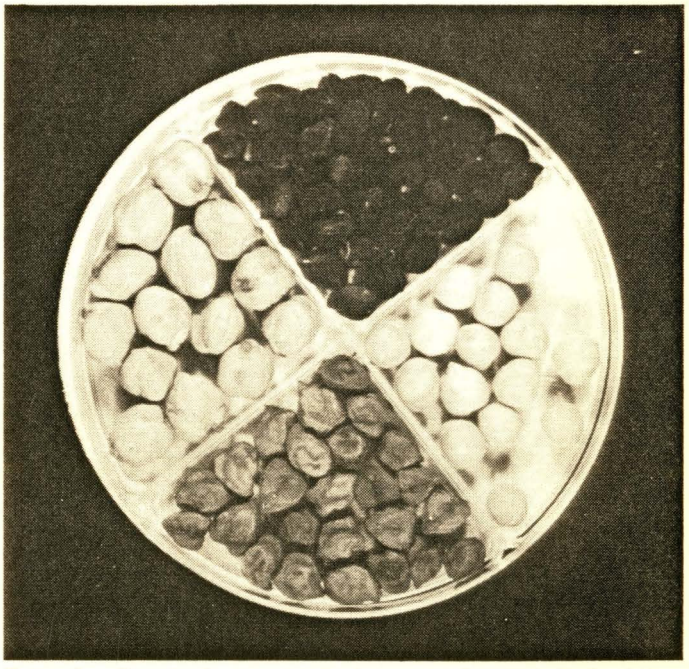

Fig 2. Desi (upper and lower) and Kabuli (left and right) chickpea seed types.

Performance Trials, South Dakota

A large number of germplasm collections from the International Center for Agricultural Research in Dry Areas (ICARDA) at Aleppo, Syria, were evaluated for South Dakota conditions at four locations from 1982 to 1984. Data for the five highest yielding lines in each of three performance trials are presented in tables 3,4,and 5.

The F3 populations were derived from crosses with parents that possessed resistance to Ascochyta blight, high yield, and wide adaptation. The large-seeded trial included materials which showed superior performance in regional and international trials conducted by ICARDA. Races widely grown throughout the Middle East and some materials from India and Egypt were included (Tuwafe, 1984).

Among the ICARDA materials, the small and medium seed size types were the highest yielding and best adapted to South Dakota environments. Four of the five top yielding populations in the adaptation trial are of Indian origin; and the other, SDG16, is from Turkey. All five of the high yielding populations in the large-seeded trial are from Spain. The 100-seed weight of these lines averaged 42 g, which is a little below the desirable weight for the current salad bar trade.

Approximately 80% of the more than 200 germplasm collections tested at Highmore, Wall, and Rapid City from 1982 to 1984 produced seed yields greater than 1000 lb/acre. This indicates that a large amount of the tested germplasm is relatively well adapted to South Dakota environments and should provide considerable genetic variability from which improved cultivars could be developed.

The primary reason for low yields in our South Dakota trials has been stand depletion from Ascochyta blight, a seed-borne fungal pathogen. However, several medium seed size types, including SDG16, are resistant to Ascochyta, and thus may increase crop stand.

Future research at SDSU should include further performance evaluations in additional locations and hybridization of promising medium and small-seeded types with large-seeded commercial cultivars. We need an evaluation of medium and small-seeded types as energy-rich, high protein feed supplements for livestock. Potential markets also need to be studied.

Table 3. Mean seed yields for the five top yielding medium seed size F3 and F4 populations of chickpeas grown in 1983 and 1984+.

Population	Source	1983 F3 populations		1984 F4 populations		Overall Mean
		Brookings	Highmore	Highmore	Wall	
		lbs/acre				
SDB 1	Syria	3164	1283	2331	747	1881
SDB 2	Syria	3058	1372	2311	992	1933
SDB 3	Syria	3263	1356	2584	700	1972
SDB 4	Syria	2708	1461	2852	1225	2062
SDB 5	Syria	3075	1211	2192	1031	1877
SDGI 6	Turkey	1576	1300	2822	1275	1743
Location mean		2536	1269	2386	926	
Range		1576-3263	961-2852	1915-2852	617-1275	

+F3 populations were hand-weeded and F4 populations were treated with Trifluralin for weed control. Late harvest and late summer rains resulted in severe pod drop and reduced yields in F4 populations at Wall.

Table 4. Mean seed yields for the five top yielding populations in the large-seeded chickpea trial conducted in 1983 at Highmore and Rapid City.

Population	Source	Highmore	Rapid City	Overall mean
		lbs/acre		
SDGI 1	Spain	2756	2582	2669
SDGI 2	Spain	2413	2813	2613
SDGI 3	Spain	2413	2711	2562
SDGI 4	Spain	2346	2764	2555
SDGI 5	Spain	2468	2353	2411
Location mean		2207	2468	2155
Range		1094-2756	1603-2813	

Table 5. Mean seed yields for the five top yielding medium- to small-seeded populations in the chickpea adaptation trial grown at three locations[+].

Population	Source	Seed size[‡]	Brookings 1982	Highmore 1982	Highmore 1983	Rapid City 1983	Overall mean
			----------lbs/acre----------				
SDGI 6	Turkey	M	2447	5192	1214	2901	2939
SDGI 7	India	S	743	4565	1938	3376	2657
SDGI 8	India	S	992	4242	1544	2803	2395
SDGI 9	India	S	1139	4095	1185	2672	2273
SDGI 10	India	S	995	3914	1475	2554	2234
Location mean			889	3214	1174	2588	1966
Range			220-2447	1484-5192	615-1938	1822-3376	

[+]Comparisons should be made only between populations within locations and years, because of differences in harvesting methods and hand versus chemical methods of weed control. For example, the relatively low yields for some populations at Brookings in 1982 and Highmore in 1983 were most likely due to weed competition early in the growing season or hand weeding just prior to flowering which may have caused differential root damage. Trifluralin was used for weed control at Rapid City in 1983.

[‡]S = small-, M = medium-seed size.

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REFERENCES

Auld, D.L., R.H. Callihan, G.A. Murray, L.E. O'Keeffe, and B.L. Bettis. 1982. Garbanzo beans - a potential new pulse crop for Idaho. U of Idaho AES Bul 615.

_____, J.E. Crock, M.J. Silbernagel, B.L. Bettis, and G. Singh. 1985. Registration of Lyons and Aztec chickpeas. Crop Sci 25:365.

Baldridge, D.E., L.E. Welty, and R.H. Lockerman. 1982. Garbanzo beans in Montana. MSU CES folder 239.

Boe, A., and S. Tuwafe. 1983. Chickpea research, progress report. SDSU Plant Science Department Pamph #73.

Duke, J.A. 1981. Handbook of legumes of world economic importance. Plenum, NY.

Food and Agriculture Organization of the United Nations (FAO). 1983. FAO Production Yearbook 37. FAO, Rome.

Gonzalez, A., W.H. Martinez, and V.L. Frampton. 1960. Effect of autoclaving on the basic amino acids and proteins of the chickpea. Agric and Fd Chem 8:331.

Meuhlbauer, F.J., R.W. Short, W.J. Kaiser, D.F. Bezdicek, K.J. Morrison, and D.G. Swan. 1982. Description and culture of chickpeas. WSU CES EB 112.

Pond, W.G., and J.H. Maner. 1984. Swine production and nutrition. AVI Pub Co, Westport, CT.

Tannous, R.I., J.W. Cowan, F. Rinnu, R.J. Asfour, and Z.I. Sabry. 1965. Protein-rich food mixtures for feeding infants and preschool children in the Middle East. Am J Clin Nut 17:143.

Tuwafe, S. 1984. Genetic variation in chickpea (*Cicer arietinum* L). PhD thesis, SDSU.

_____ and A. Boe. 1982. Chickpea research, progress report. SDSU Plant Science Department Pamph #77.

_____ and _____. 1984. Chickpea research, progress report. SDSU Plant Science Department Pamph (in press).

_____ and _____. 1985. Chickpea research, progress report. SDSU Plant Science Department Pamph (in press).

Cover photo: Mature chickpea plants with heavy pod set at Highmore in 1983.

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