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Chickpea, Faba Bean, Lupin, Mungbean, and Pigeonpea: Potential New Crops for the Mid-Atlantic Region of the United States

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The New Crops Program of Virginia State University, established in 1991, has evaluated the production feasibility of a wide array of leguminous crops including chickpea, faba bean, mungbean, and pigeonpea under Virginia's agro-climatic conditions (Bhardwaj et al. 1996). Such crops could provide alternatives to farmers in Virginia and adjoining Mid-Atlantic States. These farmers, in general, rely on a limited number of crops and are interested in diversification. The close proximity of these farmers to the Washington, DC metropolitan area where the international community is familiar with these crops can provide a market for these crops.

The evaluations of chickpea, pigeonpea, and mungbean were conducted as replicated field experiments. The evaluations of faba bean and lupin germplasm were conducted by planting single row plots of each accession. All field experiments were conducted at the Randolph Farm of Virginia State University which is located approximately 37° 15' N and 077° 30.8' W.

CHICKPEA

Cicer arietinum L., an ancient crop, was probably grown in Turkey 7400 years ago. Most chickpea world production is in India. The mature chickpea seed are used as a dry bean and green immature seed are used as a vegetable. In chickpea, two seed types exist: *kabuli* or garbanzo (large seeded) and *desi* (small seeded). Chickpea is an annual plant generally requiring a cool season. However, it can be planted in spring in Virginia. The chickpea plant is 20–100 cm tall. Chickpea has a deep tap root and is considered drought tolerant.

The results of chickpea evaluations are presented in Table 1. The mean yield of *desi* type chickpea lines (1153 kg/ha) was significantly higher than that of *kabuli* type lines (719 kg/ha). However, the larger kabuli-type chickpea are known to be sold at premier prices at the green-immature stage for use as a vegetable. Recent research has indicated that 'Sanford' and 'Dwelly' (*kabuli* type cultivars) and 'Myles' (*desi* type cultivar) are adaptable and high yielding in Virginia.

FABA BEAN

Vicia faba L. is known to be an efficient nitrogen fixer and there is interest among farmers to grow faba bean as a vegetable crop to market the green beans in the Washington, DC metropolitan area. The faba bean is generally a cool season crop but can be planted in Virginia during spring. A diverse germplasm collection of faba bean germplasm has been evaluated for production potential. This collection has included lines from ICARDA (Syria); US collection at Pullman, Washington; and lines from Dr. Al Slinkard (University of Saskatchewan, Saskatoon, Canada). The seedling and foliar diseases have been a major hindrance in faba bean production under Virginia conditions. Although our results with faba bean have been disappointing, two cultivars, 'Fatima' and 'Chinese', seem to have promise under Virginia conditions.

LUPIN

White lupin (*Lupinus albus* L.) is making a comeback in the southern United States due to its high potential in both conventional and sustainable production systems. Since 1997, white lupin is being evaluated in

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Virginia as a winter grain legume crop and as a green manure crop to meet nitrogen needs of following summer crops. Lupin can potentially fix 150 to 200 kg/ha nitrogen for the use of a succeeding crop (Reeves et al. 1990). It has been estimated that if lupin replaced a quarter of wheat area in the southeastern United States, 95000 t of nitrogen fertilizer worth $50 to $60 million per year could be saved (Reeves et al. 1990).

The fiber-rich lupin flour is also gaining attention as a food source for humans. The nutritionally-rich lupin flour, due to its high content of potassium, calcium, carotenes, and protein, can be used to enrich pastas, cake mixes, cereals, and other baked goods (Birk 1993). Sweet lupin have been observed to be good sources of macro- and micro-nutrients, protein, fat, carbohydrates, minerals, and vitamins (Yanez 1996) for normal growth and development of humans and other animal species. Sweet lupin seeds lack trypsin inhibitors and can make a valuable contribution to dairy, beef, swine, sheep, and poultry rations at the farm since high temperature cooking to eliminate anti-nutritional factors is not needed. A survey of historic weather data for Virginia (1961–1990), has indicated that successful lupin production in Virginia and the mid-Atlantic region would get a boost from development of cold-tolerant lines.

During fall of 1997, a lupin collection of 284 lines representing four species: *Lupinus albus, L. angustifolius, L. luteus,* and *L. mutabilis,* were evaluated for cold tolerance and 148 selected lines are now being evaluated for yield potential and cold-tolerance. Greenhouse experiments conducted during 1997 have indicated that nodulation effectiveness was dependent upon specific *Bradyrhizobium* strain and lupin genotype combination. Lupin yields have been unstable in the mid-Atlantic region. Field experiments conducted at Orange, Virginia during 1995–96 season resulted in an average yield of 3480 kg/ha as compared to average Alabama yields of less than 1740 kg/ha (Noffsinger et al. 1998).

A comparison of lupin seed produced in Maine to that produced in Virginia (Bhardwaj et al. 1999) indicated that growing environment significantly affected total sugar, amino acids, oil, fatty acids, and minerals but not protein. The results indicated that lupin seed has potential as human food. The lupin seed produced in Virginia contained approximately 3 percent ash, 37 percent protein, 5 percent oil, and 7 percent sugar.

Table 1. Performance of *desi* and *kabuli* chickpea lines during 1993 when planted in March and harvested in July.

Line	Type	Seed yield (kg/ha)
Aztec	*Desi*	1400
ICC 4948	*Desi*	1360
ICC 10136	*Desi*	1343
C 235	*Desi*	1183
ICC 4	*Desi*	1097
NEC 1163	*Desi*	1003
Garnet	*Desi*	964
PI 12074	*Desi*	876
Mean		1153
LSD(.05)		453
UC 8532	*Kabuli*	1083
UC 85150	*Kabuli*	1047
UC 27	*Kabuli*	996
UC 15	*Kabuli*	929
UC8624	*Kabuli*	925
UC85183	*Kabuli*	811
UC5	*Kabuli*	620
SR20I	*Kabuli*	576
UC8554	*Kabuli*	559
Surutato 77	*Kabuli*	431
Surutato	*Kabuli*	349
UC8536	*Kabuli*	307
Mean		719
LSD(.05)		432

MUNGBEAN

Vigna radiata (L.) Wilczek. is native to northeastern India–Burma (Myanmar) region of Asia. It is primarily grown in Asia, Africa, South and North America, and Australia principally for its protein-rich edible seeds. Mungbean is also known as mung, *moong*, *mungo*, green gram, golden gram, chop-suey bean. Human consumption of mungbean is as dry seeds or sprouts. Mungbean also has potential as a green manure and a forage crop. In the United States, mungbean was grown as early as 1835. Oklahoma, California, and Texas account for about 90% of the US production (about 50,000 ha). Approximately, 7 to 9 million kg of mungbean are consumed annually in the United States and nearly 75% of this amount is imported (Oplinger et al. 1990). Enhanced domestic production can help offset annual imports of approximately 5 to 7 million kg of mungbean.

Seven mungbean lines were evaluated during 1993 and 1994 with encouraging results (Table 2). Mungbean planted in June or July, may be a suitable crop in rotation with winter wheat. The soybean farm machinery and production technology are generally suitable for mungbean culture. During 1997 and 1998, mungbean was commercially produced in Virginia on a small scale for sale to businesses intending to use it as a dry pulse.

PIGEONPEA

Cajanus cajan (L.) Millsp. is one of the oldest food crops of the world and ranks 5th among edible legumes in worldwide production. Pigeonpea is known to produce more nitrogen per unit of plant biomass than most other legumes and can nodulate in most soils. It is also considered to be tolerant to low and high temperatures. There is considerable variation among pigeonpea germplasm for crop duration which may vary from 80 to 250 days. Pigeonpea is useful as a grain, forage, or a green manure crop. Both determinate and indeterminate genotypes of pigeonpea exist. Seeds of pigeonpea are known to be a rich source of proteins, carbohydrates, and minerals with protein content generally varying from 18 to 25% and as high as 32%. Pigeonpea seeds are rich in sulfur-containing amino acids, methionine, and cystine. In pigeonpea, green immature seeds are used as a vegetable and could be important income for small and part-time farmers. A market for green pods of pigeonpea is known to exist in the Washington, DC metropolitan area.

During 1992, the seed yield varied from 349 to 2042 kg/ha with a mean yield of 1236 kg/ha (Table 3). The mean yield of determinate lines (1751 kg/ha) was significantly superior to that of indeterminate lines

Table 2. Seed yield of mungbean during 1993 and 1994 (Source: Bhardwaj et al. 1997).

	Yield (kg/ha)				
	1993		1994		
Entry	June 9–Oct. 6 [z]	July 7–Oct. 6	May 17–Oct. 21	June 16–Oct. 21	July 2–Nov. 29
LSB 8205	2068	1799	1955	1257	1242
Johnston's California	1758	1651	2794	2516	888
TexSprout	1535	1338	2362	3025	936
Lincoln	1522	1737	2663	1892	927
Berken	1516	1265	3263	991	805
M 12	1382	1469	2621	1885	669
OK 12	1189	1065	3287	2258	848
Mean	1567	1475	2706	1975	902
LSD(.05)	414	298	745	1118	ns

[z]Planting and harvest dates.

Table 3. Performance of pigeonpea during 1992 in Virginia.

						Green bean		
Line	Type	Seed yield (kg/ha)	No. seeds/pod	Seed wt (g/100)	Harvest index (%)	Yield (kg/ha)	Moisture (%)	Shelling (%)
VXPP-I1	Determinate	1925	4.9	11.8	20.2	13184	78.9	52.1
VXPP-I2	Determinate	2042	4.2	9.2	28.4	15696	82.4	53.7
VXPP-I3	Determinate	1287	3.7	7.6	21.9	11888	84.1	55.1
VXPP-I4	Indeterminate	597	4.3	10.0	8.9	--	--	--
VXPP-I5	Indeterminate	1217	4.5	9.6	11.7	--	--	--
VXPP-I6	Indeterminate	349	4.4	10.2	4.3	--	--	--
Mean		1236	4.3	9.8	15.9	13589	81.8	53.6
LSD (.05)		494	0.5	1.4	5.1	ns	ns	ns

(721 kg/ha). A mean green bean yield of 13589 kg/ha was obtained in this study. These results indicated that pigeonpea can be successfully grown in Virginia and the mid-Atlantic region. During 1998 summer, a Virginia farmer grew about 0.4 ha of pigeonpea for marketing of green pods.

CONCLUSIONS

Based on these results, we consider chickpea, mungbean, and pigeonpea to be potential crops for the mid-Atlantic region of the United States. The possibility of producing lupin in this region seems encouraging. Faba bean evaluation indicates that seedling and foliar diseases are a major hindrance to successful production.

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