EVALUATION OF LENTILS IN SOUTH DAKOTA

Solomon Tuwafe and A. L. Kahler
Plant Science Department, South Dakota State University
Brookings, SD 57007

ABSTRACT

Lentils (*Lens culinaris* Medik., 2n=14) are grown on 1.97 million hectares around the world (FAO, 1982) and contribute about 2.5 percent of the world-wide supply of edible pulse crops. Lentils were first planted in the United States in the Palouse area of the state of Washington by J. J. Wagner in 1916 (Youngman, 1968). Presently, most US lentils are produced in eastern Washington and northern Idaho. U.S. production accounts for 5.3 percent of the edible pulse crops grown. There has been an increase in demand for lentils both in domestic and world markets (Summerfield, Muehlbauer, and Short, 1982). The outlook is excellent for lentil seed in the export market.

In 1985, advanced breeding populations (F6 and F7) and elite germplasm lines from Syria, Jordan, Mexico, and Pakistan were evaluated in a screening nursery at Highmore, South Dakota. There was considerable variability among characters studied. Plant height ranged from 15 to 30 cm, maturity varied from 85 to 110 days, seeds per pod averaged between 1.1 and 2.2, seed weight ranged from 2.9 to 5.4 g per 100 seeds, and yield ranged from 674 to 1686 kg/ha among the different lines. A positive correlation was found between seed yield and plant height. Plant height and seed size showed positive correlation with number of days to maturity. Plant height and 100-seed-weight were found to be negatively associated with number of seeds per pod. This genetic variability should permit development of the crop for agronomic production in South Dakota.

INTRODUCTION

Grain legumes are excellent sources of thiamine, niacin, calcium, and iron. They contain relatively little fat and high protein. Lentils (*Lens culinaris* Medik) are a grain legume commonly eaten with rice or in soup. Types and methods of lentil preparation for food vary with culture.

Lentils are cultivated on approximately two million hectares around the world. They contribute about 2.5 percent of the supply of edible pulse crops world-wide and 5.3 percent in the United States (Muehlbauer, Short, and Summerfield, 1981). World-wide lentils yields average 657 kg/ha (FAO 1982). In the United States the yield averages 1100 kg/ha. Over 80% of the US lentil crop is produced in eastern Washington and Idaho. Because of increased

world population, large areas of land previously used for lentils are now allocated to production of cereal crops. Hence, there is increased demand for lentils both in the domestic and world market (Summerfield, Muhehlbauer, and Short, 1982).

Zohary (1972) considered *L. orientalis* to be the wild progenitor of cultivated *L. culinaris* and suggested that domestication took place in the Near East arc (Northern Israel, Syria, Southern Turkey, Northern Iraq, and Western Iran). Erskine (1983a) reported three species, *L. culinaris, L. orientalis,* and *L. nigricans,* were interfertile and thus formed the primary gene pool of lentils.

Lentils are a long-day crop that can be grown in dry areas. The crop is reported to be sensitive to extreme heat and cold. This may be the reason it is confined to higher elevations in tropical countries or grown in the spring at high elevations in temperate countries (Summerfield and Muehlbauer, 1981). Most lentils are produced in Bangladesh, Ethiopia, India, Pakistan, Syria, and Turkey. Recently, new cultivars have made an impact on production in Algeria, Egypt, Greece, and the USA. The US produces more than 20,000 tons of the grain every year (Solh and Erskine, 1981).

The objectives of this study were to assess variability within genetically diverse lentil populations and identify high yielding genotypes suitable to South Dakota for possible use as a new crop for the state.

MATERIALS AND METHODS

Sixty-six entries of advanced breeding (F6 and F7) populations and elite germplasm received from Syria were planted at Highmore, South Dakota on April 15, 1985. Two hundred seeds of each entry were sown in single row plots 3m long with 60 and 1.5 cm spacings between and within rows, respectively. Plots were arranged in an augmented complete block design. Two checks (Syrian Local and SDL-03) were planted randomly in every block of 15 entries. Number of days to maturity (total days from seeding to 90% pod ripening), plant height, plant stand (percent of seed planted producing mature plants), number of seeds per pod (average of 10 randomly picked pods), seed size (weight of 100 randomly selected seeds), and yield (total seed yield per plot) were recorded to determine the extent of genetic variation within populations. Correlation analyses were used to identify associated characters.

RESULTS AND DISCUSSION

Plant height: Plants varied from 15 to 30 cm in height (Table 1). Over 50% of the plants were taller than 25 cm. Entries SDL-46, SDL-45, SDL-44, SDL-17 and SDL-13 had mean plant heights of 25 cm and above. These entries were considered tall.

TABLE 1

Means, Ranges, and Standard Deviations of Traits Measured on Populations Included in the Lentil International Screening Nursery (LISN-85) at Highmore, SD

Trait	Mean	Range	S.D.*	Check (Mean)	
				Syrian Local	78s 26013
Plant Height (cm)	20.2	15-30	3.4	17	20
Plant Stand (%)	91.6	70-100	10.6	80	90
Days to Maturity	93.4	85-110	5.0	90	95
Number of Seeds/Pod	1.5	1.1-2.2	0.2	1.7	1.6
100-seed Weight (g)	3.9	2.9-5.4	0.6	3.6	3.4
Yield (kg/ha)	1102.0	674-1686	246.8	804	1191

*S.D.=Standard Deviation

Plant stand: 100% stand. Plant stand ranged from 70 to 100 percent. Approximately 80% of the entries exhibited over 90% plant stand. Thirty-three of the 66 entries produced a 100% stand. The two checks, Syrian Local and SDL-03 had 80 and 90% stands, respectively.

Days to maturity: Number of days to maturity ranged from 85 to 110 days; (mean 93). Approximately 42% of the entries matured within 95 days after planting. Nine entries (SDL-21, SDL-22, SDL-23, SDL-26, SDL-27, SDL-49, SDL-55, SDL-56, and SDL-59) matured within 85 days and were designated early maturing. SDL-17 was the latest maturing entry, requiring about 110 days.

Seeds/pod: Number of seeds per pod ranged from 1.2 to 2.2; mean 1.5 among all populations. Populations SDL-10, SDL-11, SDL-37, SDL-53, and SDL-65 yielded highest seed number per pod (1.8 to 2.2 seeds).

Seed Size: Seed size ranged from 2.9 to 5.4 g/100 seeds; mean 3.9. Populations SDL-17, SDL-33, SDL-18, SDL-47, SDL-33, and SDL-34 had seed sizes ranging from 4.8 to 5.4 g/100 seeds. These entries were identified as large-seeded. SDL-48 with only 2.9 g/100 seed was identified as small-seeded. Approximately 62% of the populations had mean seed sizes ranging from 2.9 to 4.0 g/100 seed. The two checks were similar in seed size (3.4 and 3.6 g/100 seed, respectively).

Grain Yield: Grain yield ranged from 674 to 1686 kg/ha; mean yield 1102 kg/ha. Nearly 40% of the populations had mean yields ranging from 1003 to 1194 kg/ha. Eleven entries had mean yields higher than 1400 kg/ha (Table 2).

Correlations among traits:

Positive significant correlation was observed between grain yield and plant height (Table 3). This suggested the possibility of selecting tall, high yielding genotypes suitable for mechanical harvest. The highly significant positive correlation values observed for number of days to maturity with plant height and seed size suggests tall and large-seeded genotypes are relatively late maturing. The negative associations of seeds/pod with seed size and seed yield indicated small-seeded genotypes produce low yields. Further, the negative correlation between plant height and seeds/pod indicated short genotypes have larger numbers of seeds per pod.

This nursery revealed considerable genetic variability within and among populations as determined by means, ranges, and standard deviations of the traits measured. The variability observed provides an opportunity for selecting high yielding superior

TABLE 2

Name and Description of the High Yielding Lentil Populations Evaluated At Highmore, SD in 1985

Population	Source	Traits					
		Plant Height (cm)	Plant Stand (%)	Days to Maturity	Seeds/ Pod	100-Seed Weight (g)	Yield (Kg/ha)
SDL - 62	ICARDA	23	90	95	1.2	4.6	1686
SDL - 65	ICARDA	21	90	90	1.8	3.9	1557
SDL - 64	ICARDA	24	90	90	1.4	4.4	1534
SDL - 50	ICARDA	19	100	95	1.7	4.1	1528
SDL - 51	ICARDA	17	100	95	1.4	3.9	1516
SDL - 58	ICARDA	18	100	90	1.5	4.7	1485
SDL - 63	ICARDA	20	90	95	1.4	3.7	1471
SDL - 22	ICARDA	17	70	85	1.5	3.4	1465
SDL - 12	ICARDA	24	100	90	1.6	3.2	1458
SDL - 60	ICARDA	23	100	100	1.6	4.3	1424
SDL - 48	ICARDA	22	100	90	1.3	2.9	1404
Overall Mean		20	92	93	1.5	3.9	1102

TABLE 3

Correlation Coefficients Among Five Desirable Agronomic Traits in 66 Lentil Populations Grown at Highmore, SD in 1985

Trait	Plant Height	Seeds/Pod	Seed Size	Seed Yield
Days to Maturity	0.39**	0.08	0.47**	−0.01
Plant Height		−0.19	0.08	0.26*
Seeds/Pod			−0.21	−0.14
Seed Size				0.11

*, ** significant at 0.05 and 0.001 probability levels

genotypes. The significant positive association between plant height and seed yield suggests that both traits can be improved simultaneously. Tall, high yielding plants are desirable for mechanical harvesting.

Although this study was conducted in only one environment in a single year, the results suggest that lentils have "new crop" potential in South Dakota.

REFERENCES

Erskine, W. 1983a. Lentil Genetic Resources. In: Proceedings of the International Workshop on Faba Beans, Kabuli Chickpeas, and Lentils in the 1980s (Saxena, M. C. and Varma, S., eds.). ICARDA, 16-20 May 1983, Aleppo, Syria. pp. 29-33.

————, 1983b. Perspectives in Lentil Breeding. In: Proceeding of the International Workshop on Faba Beans, Kabuli Chickpeas, and Lentils in the 1980s (Saxena, M. C. and Varma, S., eds.). ICARDA, 16-20 May 1983. Aleppo, Syria. pp. 91-100.

Food and Agriculture Organization of the United Nations (FAO). 1982. FAO - Statistics Series. No. 47. FAO Production Year Book, 36:137, FAO, Rome.

Muehlbauer, F. J., R. W. Short, and R. J. Summerfield. 1981. Description and Culture of Lentils. College of Agriculture, Washington State University. Pullman, Washington Experimental Bulletin 0957.

Solh, M. and W. Erskine. 1981. Genetic resources. pp. 53-59 in Lentils (Webb, C. and Hawtin, G., Eds.). Common Wealth Agricultural Bureau, Farnham, U. K.

Summerfield, R. J. and F. J. Muehlbauer. 1981. Controlled Environment as an adjunct to field research on Lentils (**Lens culinaris**). Perspectives, tenets, and objectives. Expl. Agric. 17:363-372.

Summerfield, R. J., F. J. Muehlbauer, and R. W. Short. 1982. Description and Culture of Lentils, U.S. Department of Agriculture, Production Research Report No. 181.

Youngman, V. E. 1968. Lentils—A Pulse of the Palouse. Economic Botany 22:135-139.

Zohary, D. 1972. The wild progenitor and the place of origin of the cultivated Lentil (**Lens culinaris**). Economic Botany 26:326-332.