▼ Journal of Research (Science), Bahauddin Zakariya University, Multan, Pakistan.
Vol.15, No.1, June 2004, pp. 91-95 ISSN 1021-1012

# PERFORMANCE OF CHICKPEA GENOTYPES UNDER SWAT VALLEY CONDITIONS

Ayub Khan, M. Rahim, F. Ahmad and A. Ali
Agriculture Research Station, Mingora, Swat, North West Frontier Province, Pakistan.
email: peerayub@yahoo.com

**Abstract:** Twenty-two genetically diverse chickpea genotypes were studied for their physiological efficiency to select the most desirable genotype/genotypes for breeding program on chickpea. Genotype "CM7-1" was found physiologically efficient stain with maximum harvest index (37.33%) followed by genotype "CM 1571-1-A" with harvest index of 35.73%. Genotype "90206" produced maximum biological yield (7463 kg $ha^{-1}$) followed by genotypes "CM31-1" and "E 2034" with biological yield of 7352 and 7167 kg $ha^{-1}$, respectively. Harvest index and economic yield showed significant positive correlation value of (r = +0.595), while negative correlation value of (r = -0.435) was observed between harvest index and biological yield.

**Keywords:** Biological yield, Chickpea, Correlation, Economic yield, Genotypes, Harvest Index, Swat valley.

## INTRODUCTION

Harvest index is the ratio between total bio mass and economic yield. Pulses generally exhibit low harvest index as compared with cereals. Park [1988] reported that parameters like biological yield and harvest index are closely related to sink size, source activity and sink source ratio. Olsen [1982] reported that photosynthesis, dark reaction and the partitioning of assimilates are the essential prerequisite for increased and stable plant productivity.

Yield is positively correlated with an adequate production of photo-synthetic assimilates and an adequate storage capacity to accept the product of photosynthesis. Bhagsari and Brown [1976] compared photosynthesis between wild and modern peanut cultivars for higher yield and reported that the modern cultivars (with high yield potential) had the highest photosynthetic rates than the wild cultivars. Similarly positive correlation between net photosynthesis and yield were reported in soybean [Christy and Porter 1982], in wheat [Puckridge 1971], in sorghum [Kanemasu and Hiebsch 1975] and in maize [Victor and Musgrave 1979].

Varietal difference for harvest index in chickpea and mongbean have been reported by Singh *et al*. [1980], Malik *et al*. [1981, 1986]. Fida *et al*., [1993] evaluated 25 early maturing rice genotypes for physiological efficiency to select the best one for use in future breeding program, harvest index and grain yield had highly significant positive correlation (r = +0.696) while negative correlation (r = -0.052) was found between harvest index and biological yield. Improved harvest index has been responsible for the grain yield potential increase among successively developed cultivars of the major cereal species over the past century [Frey 1981]. The doubling of pod yield in peanut was due primarily to increased harvest index rather than to increased total yield [Gifford *et al.* 1984].

Such results concerning the importance of changes in dry weight partitioning between organs have focused attention on harvest index as a specific selection criterion for plant breeders. This study was carried out to identify physiologically efficient genotypes (if any) in the recently introduced exotic and indigenous chickpea genotypes and their further utilization in a breeding program.

## MATERIALS AND METHODS

Twenty one chickpea genotypes viz., CM7-1, 891741-K, CMN-426-1, ICC11514 X ILC 3279-A 4/23, CM 1571-1-A, CM 31-1, ICC 11514 X ILC 3279-A4/14, AUG-648M, CM-72-ILC 3279-A2/26, 89023, V-89120, 89178, ICC 11514 X ILC 3279-A4/17, ICC 11514 X ILC 482, CMN-446-4, 90206, 90248, 89169, E 2034, 88194 and 90122, of diverse origin (India, Syria and Pakistan) were tested with one local variety Punjab-1, at Agriculture Research Station (N) Mingora Swat, (1150 m, 72º21'E and 34º46'N) during rabi 1999. The experiment was laid out in randomized complete block design with four replications. Plot size measured as 5 x 2.4 m. A basal dose of fertilizer was given at a rate of 25 N and 60 $P_20_5$ kg ha$^{-1}$ in the form of DAP and urea.

All agronomic operations like weeding, hoeing and plant protection measures were adopted as and when required equally for all plots. However, at physiological maturity ten plants were selected randomly in each plot and data on plant height, pod plant$^{-1}$, seeds pod$^{-1}$ and branches plant$^{-1}$ were recorded. Vegetative period and maturity period duration were noted when 50% of the plants attained their 50% flowers and 80% plants showed complete senescence, respectively.

Biological and economical yield data were recorded from two central rows of net plot size of 5 x 1.2 m. Biological yield was calculated as the total biomass (above ground) just before threshing. Harvest Index was calculated using the formula reported by Yoshida [1981].

$$\text{Harvest Index \% (HI \%)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

The data were statistically analyzed using MSTATC, a computer software package. Correlation was calculated by using the "CORRELATION" sub-program of the same package [Bricker 1991].

## RESULTS AND DISCUSSION

Statistically analyzed data (Table 1) showed significant variation among parameters for different genotypes at 5% level of probability. Seed yield ranged from 1012 kg ha$^{-1}$ to 2299 kg ha$^{-1}$, biological yield from 3704 to

7463 kg ha$^{-1}$ and harvest index from 21.35% to 37.33% (Table 2). The highest seed yield (2299 kg ha$^{-1}$) was recorded for genotype "89023" followed by genotype CM7-1 (2163 kg ha$^{-1}$). While minimum seed yield was noted for genotype "89178" (1012 kg ha$^{-1}$). Genotype "891741-K" had lower harvest index (21.35%) compared to genotype CM7-1 (37.33%) that was attributed due to higher biological yield. Similar trend was revealed by other varieties in the test. The highest harvest index was observed for genotype "CM7-1" (37.33%) followed by genotype CM1571-1-A (35.73%) exhibiting their physiological efficiency for appropriate portioning of total bio mass in to straw and seed. Other varieties in the test were efficient in accumulating dry matter but inefficient in portioning of assimilated dry matter in to seed. Maximum variation in harvest index indicated the possibility of improving harvest index and hence boosting up seed yield. The studies are in agreement with findings of Singh *et al.* [1980], Malik *et al*. [1986] and Fida *et al*. [1993].

**Table 1:** Yield and its components of chickpea genotypes at Agriculture Research Station (N) Mingora, Swat.

| Genotypes | Maturity (days) | Plant height (cm) | No. of Pods plant$^{-1}$ | No. of Seeds pod$^{-1}$ | Branches plant$^{-1}$ | Seed yield (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|
| CM7-1 | 197 | 58 | 41 | 1.9 | 5.0 | 2163 |
| 891741-K | 193 | 59 | 31 | 1.5 | 5.3 | 1250 |
| CMN-426-1 | 188 | 57 | 24 | 1.7 | 5.3 | 1420 |
| ICC11514 X ILC 3279-A 4/23 | 190 | 61 | 31 | 1.5 | 6.6 | 1467 |
| CM 1571-1-A | 196 | 59 | 37 | 1.7 | 3.6 | 2117 |
| CM 31-1 | 190 | 71 | 28 | 1.9 | 3.7 | 1738 |
| ICC 11514 X ILC 3279-A4/14 | 193 | 61 | 31 | 1.7 | 6.4 | 1512 |
| AUG-648M | 193 | 64 | 26 | 1.9 | 5.1 | 1532 |
| CM-72-ILC 3279-A2/26 | 190 | 68 | 34 | 1.5 | 5.4 | 1630 |
| 89023 | 188 | 57 | 20 | 1.9 | 3.3 | 2299 |
| V-89120 | 191 | 63 | 20 | 1.8 | 3.9 | 1489 |
| 89178 | 194 | 62 | 25 | 1.1 | 4.8 | 1012 |
| ICC 11514 X ILC 3279-A4/17 | 190 | 51 | 24 | 1.5 | 4.4 | 1626 |
| ICC 11514 X ILC 482 | 196 | 57 | 30 | 1.9 | 4.4 | 1295 |
| CMN-446-4 | 191 | 64 | 30 | 1.7 | 4.5 | 1498 |
| 90206 | 193 | 68 | 25 | 1.9 | 4.5 | 1775 |
| 90248 | 193 | 60 | 29 | 1.5 | 4.9 | 1489 |
| 89169 | 192 | 60 | 44 | 1.2 | 6.6 | 1346 |
| Punjab-1 (check) | 201 | 66 | 27 | 1.7 | 4.1 | 1265 |
| E 2034 | 198 | 67 | 32 | 1.5 | 3.7 | 1615 |
| 88194 | 195 | 60 | 30 | 1.5 | 3.1 | 1327 |
| 90122 | 191 | 58 | 27 | 1.6 | 4.8 | 1722 |
| LSD $P < 0.05$ | 4.47 | 6.19 | 2.93 | 0.26 | 1.35 | 722 |

**Table 2:** Days to 50% flowering, economic yield, biological yield and harvest indices of chickpea genotypes at Agriculture Research Station (N) Mingora, Swat.

| Genotypes | Days to 50 % flowering | Biological yield (kg ha$^{-1}$) | Economic yield (kg ha$^{-1}$) | Harvest index (%) |
|---|---|---|---|---|
| CM7-1 | 146 | 5796 | 2163 | 37.33 |
| 891741-K | 146 | 5870 | 1250 | 21.35 |
| CMN-426-1 | 145 | 6241 | 1420 | 22.77 |
| ICC 11514 X ILC 3279-A4/23 | 144 | 4574 | 1467 | 32.06 |
| CM 1571-1-A | 143 | 5926 | 2117 | 35.73 |
| CM31-1 | 148 | 7352 | 1738 | 24.99 |
| ICC 11514 X ILC 3279- A4/14 | 145 | 4759 | 1512 | 32.11 |
| AUG-648 | 142 | 6981 | 1532 | 21.94 |
| CM-72-ILC 3279-A2/26 | 147 | 5130 | 1630 | 31.96 |
| 89023 | 147 | 6722 | 2299 | 34.16 |
| V-89120 | 152 | 5370 | 1489 | 27.94 |
| 89178 | 142 | 4685 | 1012 | 21.95 |
| ICC 11514 X ILC 3279- A4/17 | 143 | 5056 | 1626 | 32.86 |
| ICC 11514 X ILC 482 | 147 | 3704 | 1295 | 32.43 |
| CMN-446-4 | 143 | 5056 | 1498 | 29.57 |
| 90206 | 143 | 7463 | 1775 | 23.80 |
| 90248 | 147 | 5426 | 1489 | 27.50 |
| 89169 | 141 | 6111 | 1346 | 22.36 |
| Punjab-1 (check) | 149 | 5556 | 1265 | 22.78 |
| E 2034 | 152 | 7167 | 1615 | 23.67 |
| 88194 | 147 | 5500 | 1327 | 25.03 |
| 90122 | 147 | 5370 | 1722 | 32.41 |
| LSD 5% | 8.22 | 1134 | 603 | 7.43 |
| C.V.(%) | 3.42 | 12.04 | 23.08 | 16.02 |

Simple correlations were determined among harvest index, economic yield and biological yield (Table 3). Correlation coefficient study among these parameter revealed that harvest index and economic yield were positively and significantly correlated (r = + 0.595) while harvest index and biological yield were negatively correlated (r = -0.435) (Table 3). Theses results are in agreement with the findings of Singh *et al*. [1980], Gifford *et al*. [1984] and Fida *et al*. [1993].

**Table 3:** Correlation coefficient among economic yield, biological yield and harvest indices for chickpea genotypes.

| Traits | Biological yield (kg ha$^{-1}$) | Economic yield (kg ha$^{-1}$) |
|---|---|---|
| Harvest index (%) | -0.435 * | 0.595 ** |
| Biological yield (kg ha$^{-1}$) | | 0.266 NS |

An asterisk indicates significance at P < 0.05 (*) and P < 0.01(**). NS = Non Significant.

Higher positive relationship between harvest index and economic yield evidently suggested that in varieties where yield of seeds was recorded to be higher, partitioning of dry matter was relatively more in favor of seeds. These results, therefore, indicated that harvest index may serve as indices for identifying chickpea varieties with higher seed yield. Thus, it can be inferred from this study that varieties having the potential of high dry matter production are of no use if they do not have the potential of converting large portion of biological yield into economic yield. Chickpea yield can substantially be increased by improving harvest index. Therefore, it is of vital importance to give due attention to harvest index while selecting chickpea varieties for commercial cultivation.

**References**

Bricker, B. (**1991**) "MSTATC: A microcomputer program for the design, management and analysis of agronomic research experiments", Crop and Science Department, MSU, East Lansing MI 48824 USA.

Bhagsari, A.S. and Brown, R.H. (**1976**) "Photosynthesis in peanut (*Arachis*) genotypes", *Peanut Sci*., 3, 1-5.

Christy, A.L. and Porter, C.A. (**1982**) "Canopy photosynthesis and yield in Soybean", In: Govindjee (Ed.), *Photosynthesis-Applications to Food and Agriculture*, Academic Press, New York.

Fida, M.A., Sagar, M.A. and Rabbani, A. (**1993**) "Evaluation of rice genotypes for harvest index. Pakistan J. Agric. Res. 14 (1): 18-21.

Frey, K.J. (**1981**) "Capabilities and limitations of conventional breeding", In: K.O. Rachie and J.M. Lyman (Eds.), *Genetic Engineering for Crop Improvement*, The Rockefeller Foundation, New York, pp. 15-62.

Gifford, R.M., Thorne, J.H., Hatz, W.D. and Giaquinta, R.T. (**1984**) "Crop productivity and photo assimilate partitioning", *Science*, 225, 801-808.

Malik, B.A., Hussain, S.A. and Haqqani, M.A. (**1981**) "Harvest index in chickpea", *Pakistan J. Agric. Res*., 2, 219-221.

Malik, B.A., Tahir, M., Hussain, S.A. and Choudhry, A.H. (**1986**) "Identification of physiologically efficiently genotypes in mung bean", *Pakistan J. Agric. Res*., 7, 41-43.

Kanemasu, E.T. and Hiebsch, C.K. (**1975**) "Net carbon exchange of wheat, sorghum, and soybean", *Can. J. Bot*. 53, 382-389.

Olsen, S.R. (**1982**) "Removing barriers to crop productivity", *Agron. J*. 74(1), 1-3.

Park, S.T. (**1988**) "Biological yield and harvest index in relation to major cultivation methods in rice. 2: Effect of planting density on biological yield and harvest index", *Res. Rep. Rural Dev. Admin. Rice,* Korea Republic, 30(3), 45-58.

Puckridge, D.W. (**1971**) **"**Photosynthesis of Wheat under field conditions. III. Seasonal trends in carbon dioxide uptake of crop communities", *Aust. J. Agric. Res*., 22, 1-9.

Singh, H.P, Saxena, M.C and Sahu, J.P. (**1980**) "Harvest index in relation to yield of grain legumes", *Trop. Grain Legume Bull*., 17/18, 6-8.

Victor, D.M. and Musgrave, R.B. (**1979**) "Photosynthetic selection of *Zea mays* L. III. The relationship between $CO_2$ exchange and dry matter accumulation of two hybrids", *Crop Sci*., 19, 70-75.

Yoshida, S. (**1981**) "Fundamental of Rice Crop", International rice research institute, Los Banos, Laguna, Philippines, p. 61.