Turkish Journal of Agricultural and Natural Sciences
Special Issue: 1, 2014

TÜRK
TARIM ve DOĞA BİLİMLERİ
DERGİSİ

TURKISH
JOURNAL of AGRICULTURAL
and NATURAL SCIENCES

www.turkjans.com

Effect of Cowpea (*Vigna unguiculata* (L.) Walp.) Sowing Times Applications on the Yield and Yield Components

[a] Yeşim TOĞAY [a] Necat TOĞAY* [b] Yusuf DOĞAN
[a] Yuzuncu Yil University, Faculty of Agriculture, Department of Field Crops, Van, Turkey
[b] Mardin Artuklu University, Kiziltepe Vocational High School, 47000, Mardin Turkey
*Corresponding author: necattogay@hotmail.com

Abstract

In this research, it was aimed to determine the most suitable sowing time for cowpea in Eastern Turkey. Two cowpea genotypes (Oba and Evci) were sown at three different sowing times (15 April, 30 April and 15 May). The trial was conducted in the experimental fields of Agricultural Faculty of Yuzuncu Yıl University by using randomized split block design with the three replications in 2008 and 2009 years. Experiment was established genotypes as main plots and sowing times treatments as split plots. In the study were investigated the effect of sowing time on the plant height, numbers of branche, numbers of pod per plant and numbers of seed per plant, numbers of seed per pod, seed yield, harvest index, biological yield and 100 seed weight. While the highest mean seed yield was obtained from 30 April sowing with 1163 kg ha $^{-1}$, the lowest seed yield per area was obtained from 15 May with 1088 kg ha $^{-1}$. The results of the study indicated that sowing time (30 April) application increased significantly the seed yield. Oba population gave higher seed yield than Evci population.

Key words: Cowpea, Sowing Time, Genotype, Yield.

Introduction

Legumes have been and in some areas still is one of man's basic foodstuffs. From a nutritional point of view legumes are a good source of proteins, complex carbohydrates, some minerals and vitamins, and at the same time are poor in fats and sodium (Torija et al., 1999). Cowpea is grain legume for food consumption on the global scale with 11 294 000 hectares and 5 714 000 tonnes of production of worldwide. The area sown in Turkey is 2422 hectares producing 2111 tonnes. Mean global yield is 506 kg ha-1 870 kg ha-1 for Turkey (Anonymous, 2012). Cowpea seeds are a major source of plant proteins and vitamins for man, feed for animals, and also a source of cash income. The young leaves and immature pods are eaten as vegetables. Cowpea also plays an important role in providing soil nitrogen to cereal crops (such as maize, millet, and sorghum) when grown in rotation, especially in areas where poor soil fertility is a problem. It does not require a high rate of nitrogen fertilization; its roots have nodules in which soil bacteria called Rhizobia help to fix nitrogen from the air. It is tolerant of drought and well adapted to sandy and poor soils. However, best yields are obtained in well-drained sandy loam to clay loam soils with the pH between 6 and 7. Cowpea does not tolerate excessively wet conditions or waterlogging and should not be grown on poorly drained soil (Dugje et al. 2008). This study was conducted in order to analyze the effect of different sowing times on yield and some yield parameters in cowpea.

Materials and Methods

The field experiments were conducted in 2008 and 2009 on an alkaline soil, classified as entisols (Soil Survey, 1999) in the Zeve Campus fields of Agricultural Faculty of Yuzuncu Yıl University (longitude 43°17´E´, latitude 38°33´N´, and altitude 1655 m). Average growing season rainfall at the site of the experiment was 128.7 mm, with 77.9 mm falling in 2008 and 129.8 mm in 2009. In Table 1 average growing season temperature was 16.5 ^{0}C, being 17.4 ^{0}C in 2008 and 15.7 ^{0}C in 2009 (TSMS, 2009). The results of calcareous soil analysis were as follows: sandy loam texture, very low in organic matter and moderate in available phosphorus (Table 2). For the analyses of soils, texture was determined by Bouyoucus (1951) hydrometric method, pH in 1:2.5 soil-water suspension (Jackson, 1962), lime with 5 replicates by calcimetric methods, organic matter by modified Walkley Black method (Walkey, 1947), available phosphorus by the methods of Olsen et al. (1954), and total salt by Richard (1954). The trial was conducted in a randomized split block design with three replications. Experiment was

established genotypes as main plots and sowing times treatments as split plots. Two cowpea genotypes (Oba and Evci) were sown at three different sowing times 15 April (ST_1), 30 April (ST_2) and 15 May (ST_3). Cowpea seeds were sown 5 cm deep by hand in 10 cm rows down each plot, with a row spacing of 50 cm. At the sowing, 150 kg ha $^{-1}$ diamonium phosphate (18 % N, 46 % P_2O_5) was applied. Irrigation was given for 10 times and weed control done by hoeing 3 times after taking into consideration the state of precipitation, temperature and humidity in the soil. Measurements were made on the 10 sample plants chosen randomly from the each plots. Harvest area was 6 m^2 which excluded one row from both sides of each plot and 50 cm from both ends (Ciftci and Sehirali 1984). The effect of treatments on cowpea were analyzed using analysis of variance procedures for a split block design with the SAS (1998) statistical package. The means related with yield and yield components in cowpea were evaluated with Duncan's Multiple Range Test statistical analysis.

Table 1- Climatic data of the experimental region*

	Prepication (mm)			Mean temperature (^{O}C)			Humidity (%)		
Monts	2008	2009	LTA	2008 2007	2009 UYO	LTA	2008	2009	LTA
April	24.8	47.1	56.6	10.5	6.5	7.4	52.2	57.0	62.0
May	39.9	31.9	45.0	12.3	13.1	13.0	51.1	46.3	56.0
June	2.1	27.1	18.5	19.5	17.5	18.0	41.9	47.7	50.0
July	11.1	21.2	5.2	22.7	21.1	22.2	32.8	44.0	44.0
August	0.0	2.5	3.4	21.8	20.1	21.8	37.3	37.3	41.0
Sum	77.9	129.8	128.7						
Mean				17.4	15.7	16.5	43.1	46.5	50.6

- Van Meteorological Service LTA = Long-term average

Table 2. Some properties of the <2 mm fraction of the top 20 cm of soil used for each site

Soil properties	2008	2009
Texture	sandy loam	sandy loam
pH[A]	8.7	8.3
Clay (%)[B]	16.3	18.6
$CaCO_3$ (%)[C]	15.6	17.4
Olsen soil test P (ppm)[D]	4.84	5.11
Total Salt (%)[E]	0.019	0.020
Organic matter (%)[F]	1.84	1.79

[A] 1 : 2.5 soil : water, [B] Bouyoucos (1951), [C] lime by calcimetric methods, [D] Olsen et al. (1954), [E] Richard (1954), [F] Jackson (1962).

Results and Discussion

The means related with yield and yield components were evaluated with Duncan groups statistical and showing the differences between averages values are given in Table 3. The effect of interaction of different sowing time applications on number of seed per plant, biological yield, seed yield and harvest index in cowpea genotypes are given in Table 4.

The effects of different sowing time applications were found to be statistically significant for plant heights in both years. The highest plant heights depending on different sowing times application in two and united years

were obtained from Oba genotype and ST_1, whereas the lowest values pertained to the plant height were obtained from those plots in which Evci genotype and ST_3 application was conducted (Table 3). Kurubetta (2006) and Yadav (2003) reported that the highest plant height was obtained from second sowing time. This study also is relevant with results obtained in the trials.

Whereas the highest numbers of branch per plant in both years were obtained from Oba genotype and ST_2, the lowest value was obtained from Evci genotype and ST3. The difference between ST_1 and ST_2 applications was statistically insignificant in both years. Erman and Cıg (2009) reported that the highest number of branch per plant was obtained from Oba genotypes.

The highest number of pods plant in united years were obtained with Oba genotype (6.41 number plant^{-1}) and ST_2 (6.35 number plant^{-1}) applications and it was found to be statistically significant (Table 3). The lowest number of pods plant were obtained from Evci genotype (5.61 number plant^{-1}) and ST_3 (5.74 number plant^{-1}). The difference between ST1 and ST3 applications was statistically insignificant in 2009. Ünlü and Padem (2005) in a study conducted on cowpea reported that 30 May sowing time increased the number of pods plant.

The effects of different genotypes, sowing time applications and genotype x sowing time interaction on number of pod per plant in cowpea was found to be statistically significant in first year. The effect of genotype x sowing time interaction on number of seed per plant of the cowpea in second year of the trials was found to be statistically insignificant. In the first year, the highest number of seed per plant was obtained from Oba genotype ST_2 application. The lowest values of yield were found in Evci genotype ST_1 applications (Table 4). Similar effects were observed by Kurubetta (2006) and Yadav (2003).

The effect of different time of sowing applications on number of seed per pod of the cowpea in first year of the trials was found to be statistically insignificant. In the second year the highest number of seed per pod was obtained from Oba genotype and ST2 application. The lowest number of seed per pod was obtained from Evci genotype and ST3 application. The difference between ST1 and ST3 applications was statistically insignificant in second year. Ozdemir (2002) reported that generally cowpea has got 3-15 number of seed in pod.

The seed yield of cowpea differed significantly among the times of sowing. The second sowing time (30 April) recorded significantly higher mean seed yield (1163 kg ha^{-1}) compared to third sowing time (15 May) (1088 kg ha^{-1}) and first (1143 kg ha^{-1}) sowing (15 April). In the first year, the highest seed yield was obtained from Oba ST_2 application (1330 kg ha^{-1}). The lowest values of seed yield were found in Evci genotype ST_3 applications (936 kg ha^{-1}). The effect of and genotype x sowing time interaction on seed yield of the cowpea in second year of the trials was found to be statistically insignificant (Table 4). This findings were in conformity those reported by Dhaka et. al (1992) and Ünlü and Padem (2005).

The effect of both different time of sowing applications and genotypes on harvest index of the cowpea in first year of the trials was found to be statistically insignificant. However, genotypes, sowing time applications and genotype x sowing time interaction on harvest index in cowpea was found to be statistically significant in first year. The highest harvest index was obtained from Oba ST_2 application in 2008. The difference between this application and the one based on Evci ST_1 and Evci ST_2 was found to be statistically insignificant (Table 4). The lowest values of harvest index were found in Evci ST_3 applications. The highest harvest index was taken in Oba ST_2 application, whereas the lowest value was in Evci ST_3 application in the second year (Table 4). Similar effects were observed by for genotypes Erman and Cıg (2009).

The effects of different genotypes, sowing time applications and genotype x sowing time interaction on biological yield in cowpea was found to be statistically significant in two and united years. In the first year, the highest biological yield was obtained from Oba ST_1 application (3686 kg ha^{-1}). The difference between this application and the one based on Oba ST_2 was found to be statistically insignificant in both years. The lowest values of biological yield were found in Evci ST_1 applications (2669 kg ha^{-1}). The highest biological yield was taken in Oba ST_2 application (3727 kg ha^{-1}), whereas the lowest value was in Evci ST_3 application (2675 kgha^{-1}) in the second year. Gülümser et Al. (1989) and Unlu and Padem (2005) reported that delayed sowing times reduced biological yield.

While the highest 100 seed weight was obtained Oba genotype and ST_2 application, the lowest 100 seed weight was obtained Evci genotype and ST_3 application in two and united years. The difference between ST_1 and ST_3 applications was statistically insignificant for seed yield in 2008 and 2009. Similar effects were observed by Erman and Cıg (2009).

Table 3. Groups and means of yield and yield components of cowpea populations on the applications of dıfferent sowıng times *

Plant features	Years	Populations		Sowing times		
		Oba	Evci	15 April	30 April	15 May
Plant height (cm)	2008	45.5 a	37.7 b	43.3 a	42.2 b	39.5 c
	2009	46.7 a	39.0 b	44.5 a	43.3 b	40.8 c
	Mean	46.2 a	38.4 b	43.9 a	42.7 b	40.2 c
Num. of branch	2008	4.06 a	2.43 b	3.40 a	3.40 a	2.95 b
	2009	4.25 a	2.61 b	3.58 a	3.61 a	3.10 b
	Mean	4.10 a	2.52 b	3.49 a	3.50 a	3.02 b
Num. of pod per plant	2008	6.17 a	5.51 b	5.78 b	6.26 a	5.48 c
	2009	6.63 a	5.7 b	6.06 b	6.43 a	6.00 b
	Mean	6.41 a	5.61 b	5.93 b	6.35 a	5.74 c
Num. of seed per plant	2008	32.0 a	19.1 b	25.1 b	27.6 a	24.0 b
	2009	33.4 a	20.4b	26.5 b	29.5 a	24.8 c
	Mean	32.8 a	19.8 b	25.8 b	28.7 a	24.4 c
Num. of seed per pod	2008	5.2 a	3.5 b	4.3	4.4	4.4
	2009	5.0 a	3.6 b	4.3 ab	4.6 a	4.1 b
	Mean	5.1 a	3.6 b	4.3 b	4.5 a	4.3 b
Seed yield (kg ha^{-1})	2008	1288 a	960 b	1132 b	1155 a	1085 c
	2009	1307 a	971 b	1155 a	1172 a	1090 b
	Mean	1297 a	966 b	1143 a	1163 a	1088 b
Harvest index (%)	2008	35.7	35.6	35.7 ab	36.1 a	35.3 b
	2009	36.1	36.0	36.2 a	36.5 a	35.6 b
	Mean	35.9	35.8	36.0 b	36.3 a	35.5 c
Biological yield (kg ha^{-})	2008	3607 a	2696 b	3170 a	3199 a	3073 b
	2009	3620 a	2697 b	3190 a	3210 a	3061 b
	Mean	3612 a	2698 b	3175 a	3203 a	3064 b
100 seed weight (g)	2008	17.9 a	12.4 b	14.9 b	15.8 a	14.7 b
	2009	18.2 a	12.7 b	15.3 b	16.0 a	15.1 b
	Mean	18.0 a	12.5 b	15.1 b	15.8 a	14.8 c

* For each row within each treatment means follows by the same letter do not differ significantly at 5 % probability level following. Num Numbers

Table 4. The effect of interaction of different sowing time applications on number of seed per plant, biological yield, seed yield per unit area and harvest index in cowpea genotypes

		Number of seed per plant		Biological yield (kg ha^{-1})		Seed yield (kg ha^{-1})		Harvest index (%)	
	Sowing times	Oba	Evci	Oba	Evci	Oba	Evci	Oba	Evci
2008	15 April	32.2 b	17.9 e	3686 a	2669 c	1300 b	963 de	35.3 bc	36.1 a
	30 April	34.6 a	20.5 d	3673 a	2726 bc	1330 a	980 d	36.2 a	35.9 a
	15 May	29.1 c	18.9 de	3461 b	2676 c	1233 c	936 e	35.6 ab	35.0 c
2009	15 April	33.0	20.0	3687 a	2709 c	1317	993	35.7 bc	36.6 a
	30 April	36.7	22.3	3727 a	2689 c	1363	980	36.5 a	36.4 a
	15 May	19.0	19.0	3438 b	2675 c	1240	940	36.1 ab	35.1 c

* For each row within each treatment means follows by the same letter do not differ significantly at 5 % probability level following

Conclusion

While the highest mean seed yield was obtained from 30 April sowing with 1163 kg ha $^{-1}$, the lowest seed yield per area was obtained from 15 May with 1088 kg ha $^{-1}$. Oba population gave higher seed yield than Evci population. Delayed sowing significantly reduced the yield of seed. The increase in seed yield with Oba genotype 30 April was mainly due to significantly higher growth and yield components compared to late sowing. Information gained from this study will be utilized to develop more efficient 30 April sowing time in cowpea.

References

Anonymous, 2012.http// www.fao.org.

Bouyoucos, G. S., 1951. Recalibration of the hydrometer methods for making mechanical analysis of soil. Agronomy J. 43: 434-438.

Ciftci, C.Y. ve Sehirali, S., 1984. The determination of varies phenotype and genotype differences in dry bean species. Ankara Univ. Institute of Science Publishing No, No:Field Crops 4, Ankara pp: 17.

Dhaka, B. R., Poonia, B. L., ve Keshwa, G. L., 1992. Studies on Growth and Yield of Cowpea Varieties as Affected by Sowing Time in Semi-Arid Areas. (CAB Abst 1/93-12/94.) (Madras Agricultural Journal, 79 (9), s.412-414).

Dugje, I.Y., F. Ekeleme, A.Y. Kamara, A. Tegbaru, L.O. Omoigui, J.E. Onyibe, ve Teli I.A., 2008. Guide on pesticide use for crop production in Borno State, Nigeria. IITA, Ibadan, Nigeria.15 pp.

Erman M. ve Çığ F., 2009. Effect of different plant densities on the yield and yield Components in two cowpea (Vigna unguiculata (L.) Walp.) Populatıons. The Eight Field Crops Congress, October 19-22 2009, Hatay Vol I: page: 669-673.

Gülümser, A., Tosun, F. and Bozoğlu, H., 1989. A research on cowpea growing in Samsun ecological conditions.. O.M.University Journal of Agriculture Faculty, vol 4 (1), 49-65p, Samsun.

Jackson, M.L., 1962. *Soil Chemical Analysis.* Engle Wood Cliff-New Jersey, Prentice Hall Inc.

Kurubetta D. K., 2006. Effect of time of sowing, spacing and seed rate on seed production potentiality and quality of fodder cowpea [Vigna unguiculata (L.) Walp]. Department of Agronomy College of Agriculture, Dharwad University of Agricultural Sciences, Dharwad – 580 005.

Mbong, G. A. C. N. Akem, O. Alabi A M Emechebe ve M. D. Alegbejo., 2010. Effect of Sowing Dates on Yield and Yield Components of Cowpea Infected with Scab. Asian Journal of Agricultural Sciences 2(2): 57-62.

Olsen, S. R., Cole C.V., Watanabe F.S. ve Dean L.A., 1954. Estimation of Available Phosphorus in Soils by Extraction with Sodium Bicarbonate. Circ. U.S. Dep. Agric., p. 939.

Ozdemir S., 2002. *Food Legumes.* Hasad Publications. Istanbul.

Richard, L.A., 1954. Diagnosis and Improvement of Saline and Alkaline Soils. Handbook 60, U.S. Dept. of Agriculture.

SAS., 1998. Statistical Analysis Software. Version 6.12. SAS Institute, Cary, NC, USA.

Soil Survey Staff., 1999. Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys. USDA-NRCS, Agriculture Handbook No: 436. U.S. Government Printing Office. p.870.

Ünlü, H. ve Padem H., 2005. The Effect Of Different Sowing Times On Quality And Yield Properties Of Cowpea (*Vigna unguiculata* (L.) Walp.) In Arid and Irrigated Conditions. Süleyman Demirel University, Journal of Science Institute, 9-3.

Torija, M. E. ve C. Díez, Legumbres. In: M. Hernández, Sastre and Editors A., 1999. Tratado de nutrición, Díaz de Santos, Madrid, pp. 425–429.

TSMS., 2009. Reports of Turkish State Meteorological Service, Ankara, Turkey.

Yadav, G.L., 2003. Effect of sowing time, row spacing and seed rate on yield of cowpea under rainfed condition. Indian Journal of Pulses Research, 16 (2): 157-158.

Walkey A., 1947. A critical examination of a rapid method for determining organic carbon in soils: effect of variations in digestion conditions and inorganic soil constituents. Soil Sci. 63 (1): 251-263.