INCREASING CHICKPEA PRODUCTIVITY BY FOLIAR APPLICATION OF UREA UNDER RAINFED AND IRRIGATED CONDITIONS

Juli Nirwal* S.P. Singh* and J.D.S Panwar**

**Deptt. of Botany, Janta Vedic (P.G.) College, Baraut, Baghpat (U.P.)*
*** Division of Plant Physiology, Indian Agricultural Research Institute, New Delhi - 110012*

Abstract: To study the effect of foliar application of urea at different stages on growth and yield of four chickpea (C 235, Pusa 362, Pusa 1088 and Pusa 1053) genotypes under rainfed and irrigated conditions. Irrigated crop recorded highest number of pods per plant, higher number of seeds per pod but 100 seed weight is higher in rainfed conditions. The irrigated crop recorded an increase in seed yield of 19.20 % under irrigated condition over rained condition. C-235 produced more number of pods per plant and Pusa 362 produced high number of seeds per pod. Bolder seeds were produced by Pusa 1088 and genotype C-235 had least values of these parameters. Higher yield with Pusa 362 was obtained due to grain size and number of filled pods per plant and also seed number per pod. The highest grain yield and yield attributes were recorded with double spray of 2% urea at 50% flowering and 10 days after 50% flowering. The results also suggested that double spray of 2% urea through foliar application significantly increased the pod number, seed size, number of seeds per pod and 100 seed weight.

Keywords: Rainfed, Seed yield, Biological yield, root weight, Foliar spray of urea, Double spray

INTRODUCTION

The major area under chickpea is rainfed where, productivity is very low as compared to yield potential of different genotypes. However, water stress is one of the main abiotic stresses responsible for reducing crop productivity as it affects growth through various physiological and metabolic processes of plant (Bray 1993). Hence, there is a need for increasing crop productivity particularly in rainfed situation. The moisture stress cause severe shrinking of different phenophases of the crop which ultimately affect the assimilate supply to the developing sink. Severe stress during reproductive development, particularly after the commencement of pod set, can cause significant pod abortion (Leport *et al.* 1999) and decreased seed filling (Leport *et al.* 2006). Moisture stress is the most important for limiting productivity of chickpea (Zaman –Allah, 2011).

Foliar spray of urea solution at vegetative growth periods may help to reduce the adverse effect of moisture stress on crop plants. Foliar application of micronutrients is very helpful when the roots cannot provide necessary nutrients. Foliar application of 2% urea in different pulse crops in different region has shown a spectacular increase of 13-20% productivity of pulses (Ali and Kumar, 2007). Nutrient deficiencies are the important factors responsible for low yield in cultivars with large seeds, resulting in low pod filling and shriveled seeds, causing 10-50 % yield losses (Singh *et al.,* 2007). Foliar nutrition is known to correct the nutrient deficiencies usually observed in chickpea at pod development stage. Foliar spraying of micronutrients is very helpful when the roots cannot provide necessary nutrients. Foliar spraying is a new method for crop feeding, which micronutrients in form of liquid are used as spray over leaves. Foliar application of micronutrients is more beneficial than soil application. Farmers are unable to follow recommended doses of organic manures and fertilizers, leading to non-realization of potential yield. Low productivity because of limited mineral nutrient supply is common under various environmental conditions.

MATERIAL AND METHOD

An investigation was conducted on sandy loam soils and a pH of 7.1 at the Research Farm of the Janta Vedic (P.G.) College, Baraut, District–Baghpat (U.P.) during rabi 2008-09 and 2009-10. The experimental layout accommodated 32 treatments combinations imposed to chickpea crop, comprising two irrigation method (Rainfed and irrigated), four chickpea cultivars C-235, Pusa 362, Pusa 1088 and Pusa 1053 and four stages of 2% foliar spray of urea i.e. water spray at 50% flowering (Control), urea spray at 50% flowering, Urea spray at pod setting and double spray at 50% flowering and pod setting in sub plots, replicated trice. The crop was sown at a distance of 30 cm between lines under rainfed and irrigated conditions and sowing was accomplished on 19th November 2008 and 19th November 2009, respectively. Data on various yield attributes and yield of chickpea were recorded as per the standard procedures. The experimental data were analyzed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test and conclusions were drawn at 5% probability levels.

RESULT AND DISCUSSION

Crop recorded highest number of pods per plant as compared to rainfed conditions. As Irrigated moisture is a critical factor for good development of reproductive organs and also continued transfer of photosynthates to reproductive organs. Availability of moisture during developing reproductive sink was more effective as compared to rainfed. Irrigated condition recorded significantly higher number of seeds per pod as compared to rainfed conditions. Under irrigated condition though the seed number per pod increased but the seed size was reduced. This may be due to the fact that moisture availability at reproductive phase increases the availability of nutrients and prolong the vegetative growth by maintaining better photosynthetic rate which in turn increases the yield attributes. These findings are in corroboration with those of Durga *et al.* (2005), Dhonde *et al*. (2006), and Upadhyaya *et al.* (2011) The irrigation condition had significant impact on the seed yield of chickpea. The irrigated crop recorded an increase in seed yield of 19.20% under irrigated condition over rained condition. Availability of normal moisture for longer duration resulted in improved physiological process and production of adequate quantity of photosynthesis, which finally in development of more number of pods/plant, more number of seeds per pod and bolder seeds. Similarly, higher biological yield as was recorded under irrigated conditions whereas, minimum was recorded under rainfed conditions and enhance the availability of moisture and nutrients which, invariably increased growth and transfer of photosynthates. Mansur *et al.* (2010), Saman *et al.* (2010), Zaman-Allah *et al* (2011) suggests that some traits contribute to water saving when water does not limit plant growth and development in drought-tolerant chickpea. It is hypothesized that this water would be available for the reproduction and grain filling stages.. Because adequacy of irrigation water even during crop growth stages resulted in better photo-assimilate partitioning towards sink thus, higher harvest index in irrigated conditions.

The yield attributing characters such as number of pods per plant, number of seeds per pod and 100 seed weight were recorded significant variation among genotypes. C-235 produced more number of pods per plant and Pusa 362 produced high number of seeds per pod. Bolder seeds were produced by Pusa 1088 and genotype C-235 had least values of these parameters in both seasons. Higher yield with Pusa 362 was obtained due to grain size and number of filled pods per plant and also seed number per pod. The higher seed yield in Pusa 362 might be attributed due to higher values of yield attributes. Similar results were reported by Singh *et al*. (2005), Sheoran *et al.* (2008), Kumar *et al.* (2008).This indicates that the better yield potentiality coupled with other desirable yield components of an ideal plant type. The kabuli genotype Pusa 1088 also produced higher seed and biological yield than Pusa 1053. The harvest index indicates the conversion efficiency of non-seed parts into seed portion by turning up nutrient uptake as well as utilization. The higher harvest index in Pusa 362 genotype in comparison to other genotypes confirms the results of the investigation.

Foliar application of urea brought significant improvements in yield attributes like pods/plant, seeds/pod and 100 seed weight. The highest yield attributes was recorded in 2% urea spray at 50% flowering and pod setting stage that which was higher than the single spray at 50% flowering or pod setting and water spray. This could be one of the reasons for enhanced productivity in chickpea due to foliar application of urea at 50% flowering and pod setting stage. Application of urea at 50% flowering increased the leaf N content, which favored better photosynthesis and photosynthate-partitioning to yield attributes and resulted in higher sink size (pods, seed etc.). Behairy *et al*. (1988) and Bahr (2007) observed that low N-content in leaves at pod filling stage restricted the photosynthesis and consequently led to low sink size. However, at pod setting the application of urea might have triggered vegetative growth at the cost of reproductive development as evidenced by lower pods/plant and 100 seed weight and caused yield penalty. Zeidan (2003), El Krammy and Bahr (1999) and Palta *et al.* (2005) also recorded enhanced productivity and total biomass in pulses due to foliar application of urea.

Table 1. Yield attributes of chickpea genotypes as influenced foliar spray of urea under rainfed and irrigated conditions.

Treatments	Number of pods/plant		No of seeds /pod		100 seed weight (g)		Grain weight (g/plant)	
Genotypes	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Irrigations								
Rainfed	28.57	29.43	1.18	1.18	18.15	18.22	5.51	5.73
Irrigated	31.48	32.31	1.21	1.23	17.31	17.34	6.99	7.13
S.Em.	0.11	0.13	0.003	0.003	0.06	0.07	0.03	0.04
CD at 5%	0.33	0.40	0.01	0.01	0.18	0.19	0.10	0.11
Genotypes								
C-235	37.61	38.51	1.12	1.13	12.23	12.26	4.82	4.93
BG-362	33.62	34.41	1.24	1.24	19.05	19.10	7.15	7.33
Pusa 1053	23.03	23.80	1.19	1.20	18.32	18.41	6.24	6.56
BG-1088	25.83	26.75	1.23	1.24	21.33	21.37	6.80	6.91
S.Em.	0.15	0.19	0.004	0.004	0.07	0.08	0.05	0.05
CD at 5%	0.46	0.57	0.012	0.013	0.26	0.28	0.14	0.16

Foliar spray								
Control	26.84	27.49	1.08	1.09	17.10	17.15	5.54	5.71
50% flowering	31.45	32.56	1.24	1.25	18.09	18.18	6.67	6.86
Pod setting	28.48	29.13	1.15	1.16	17.29	17.34	5.87	6.03
50% Flow. + pod setting	33.33	34.29	1.31	1.32	18.44	18.46	6.93	7.14
S.Em.	0.38	0.39	0.01	0.01	0.21	0.23	0.06	0.07
CD at 5%	0.65	0.80	0.03	0.04	0.65	0.68	0.20	0.23

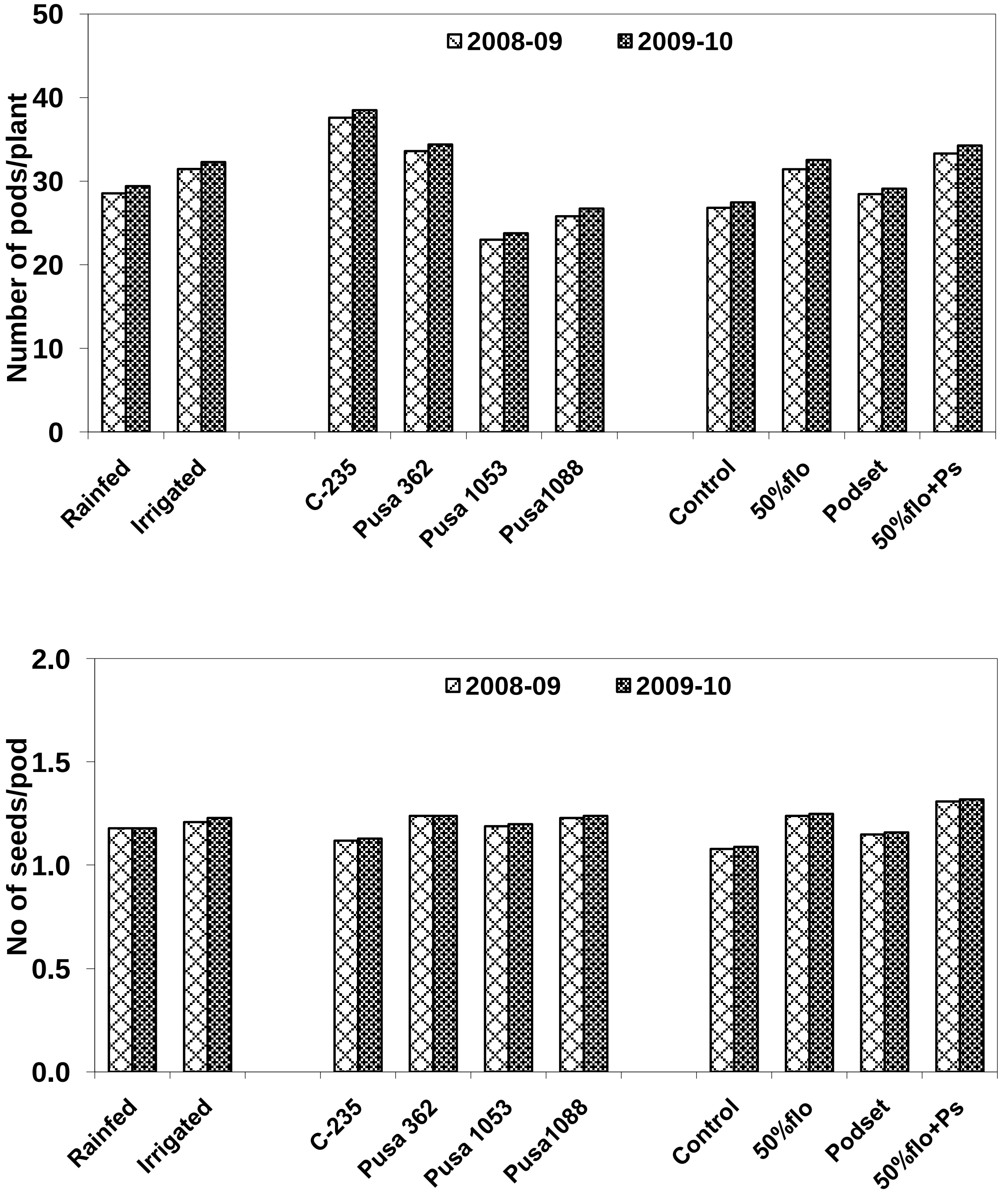
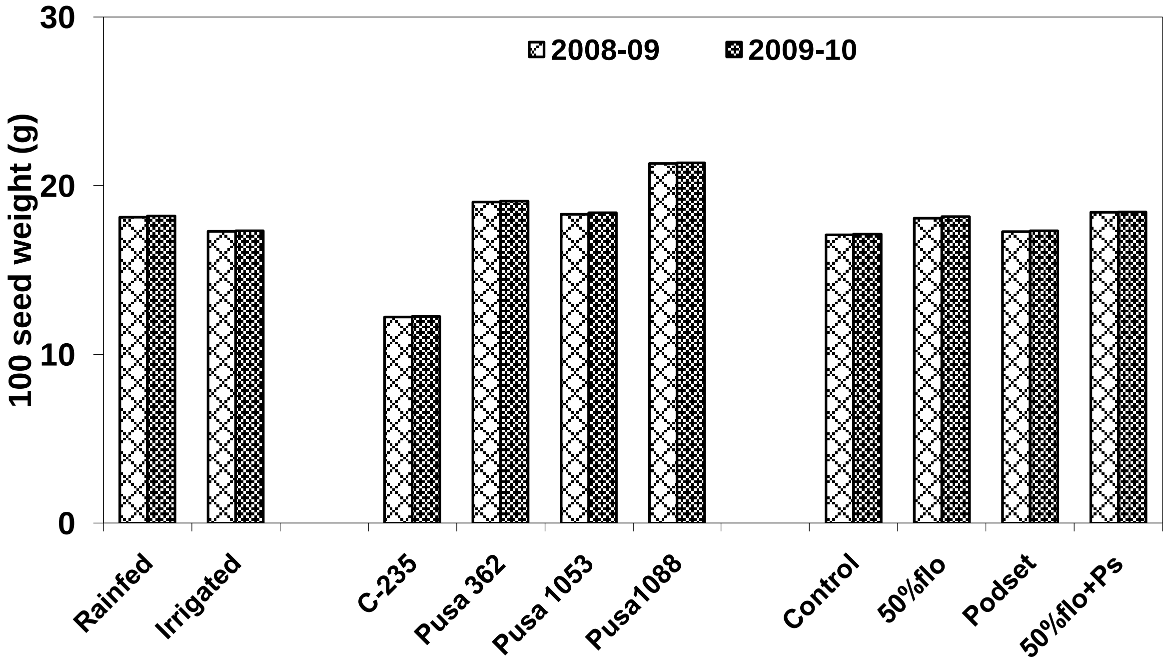


Fig 1. Number of pods/plant and number of seeds /pod of chickpea genotypes as influenced by foliar application of urea (2%) at different stages under rainfed and irrigated conditions



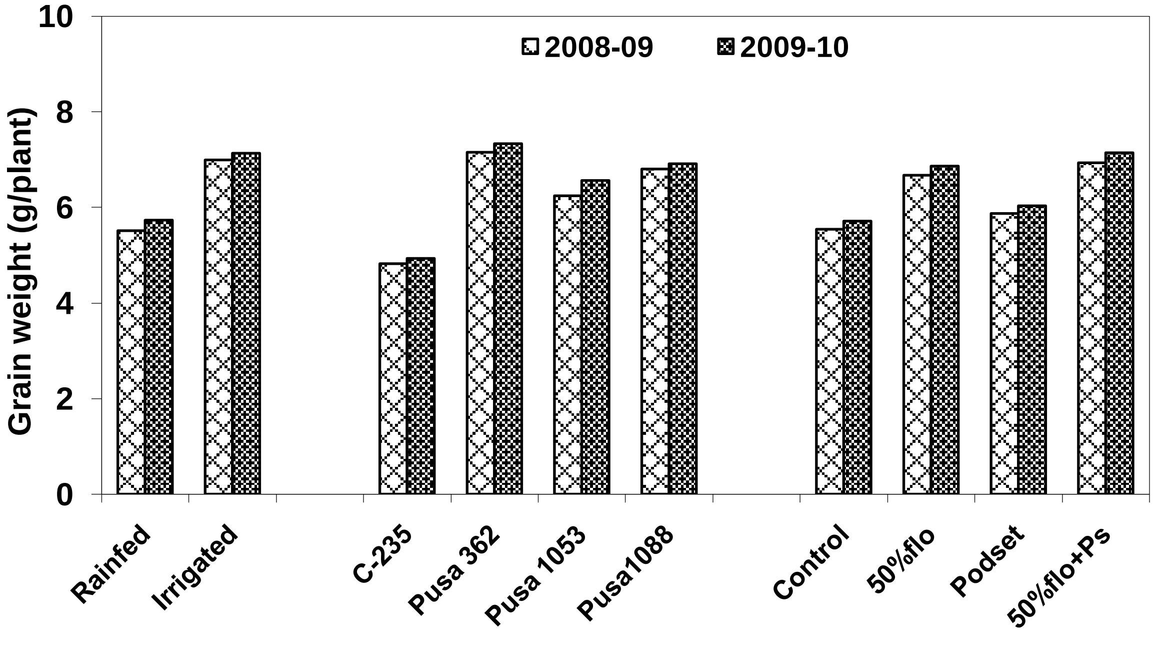
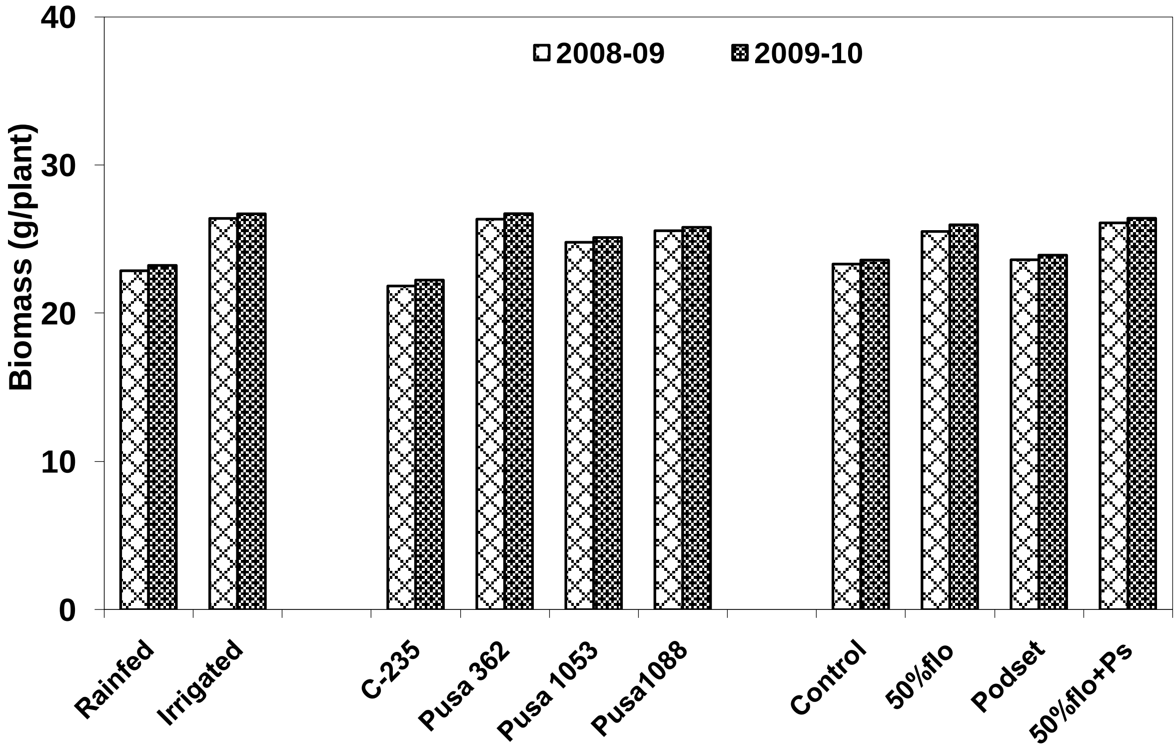


Fig 2. 100 seed weight and grain weight/plant of chickpea genotypes as influenced by foliar application of urea (2%) at different stages under rainfed and irrigated conditions

Table 2. Biomass, Grain yield, Biological yield and harvest index of chickpea genotypes as influenced foliar spray of urea under rainfed and irrigated conditions.

Treatments	Biomass (g/plant)		Grain yield (q/ha)		Biological yield (q/ha)		Harvest index (%)	
Genotypes	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Irrigations								
Rainfed	22.87	23.23	15.30	15.68	66.71	68.14	22.80	22.88
Irrigated	26.40	26.71	18.13	18.80	74.37	76.77	24.25	24.36

S.Em.	0.17	0.07	0.09	0.10	0.33	0.40	0.14	0.13
CD at 5%	0.52	0.60	0.27	0.29	1.03	1.23	0.43	0.38
Genotypes								
C-235	21.84	22.24	12.85	13.35	58.44	60.59	21.91	21.96
BG-362	26.35	26.72	19.43	19.93	78.78	80.45	24.56	24.68
Pusa 1053	24.79	25.11	16.94	17.49	70.72	72.68	23.90	24.00
BG-1088	25.57	25.80	17.65	18.19	74.22	76.12	23.73	23.84
S.Em.	0.24	0.26	0.13	0.15	0.48	0.60	0.18	0.20
CD at 5%	0.74	0.79	0.38	0.43	1.45	1.74	0.61	0.60
Foliar spray								
Control	23.32	23.59	15.07	15.48	67.42	69.03	22.23	22.30
50% flowering	25.52	25.97	17.45	18.03	71.47	73.52	24.28	24.38
Pod setting	23.61	23.92	15.88	16.46	69.15	71.43	22.84	22.92
50% Flow. + pod setting	26.10	26.41	18.46	18.99	74.12	75.84	24.76	24.87
S.Em.	0.35	0.36	0.18	0.19	0.71	0.80	0.29	0.30
CD at 5%	1.05	1.10	0.54	0.58	2.05	2.46	0.87	0.87



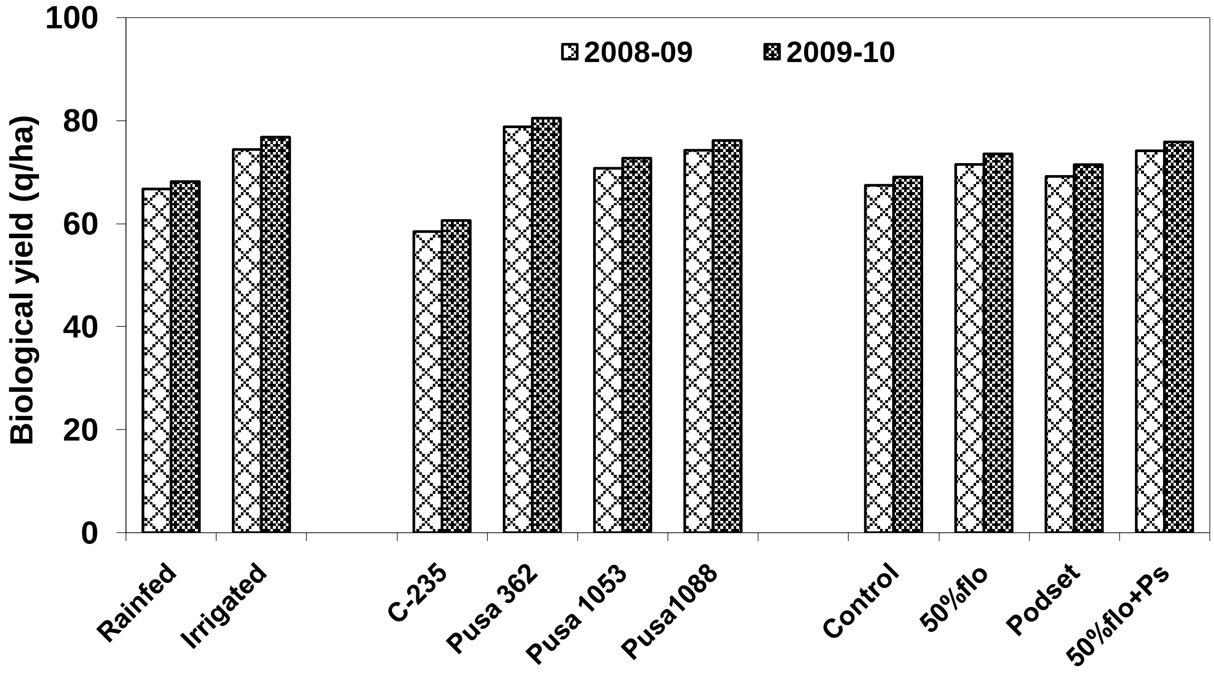
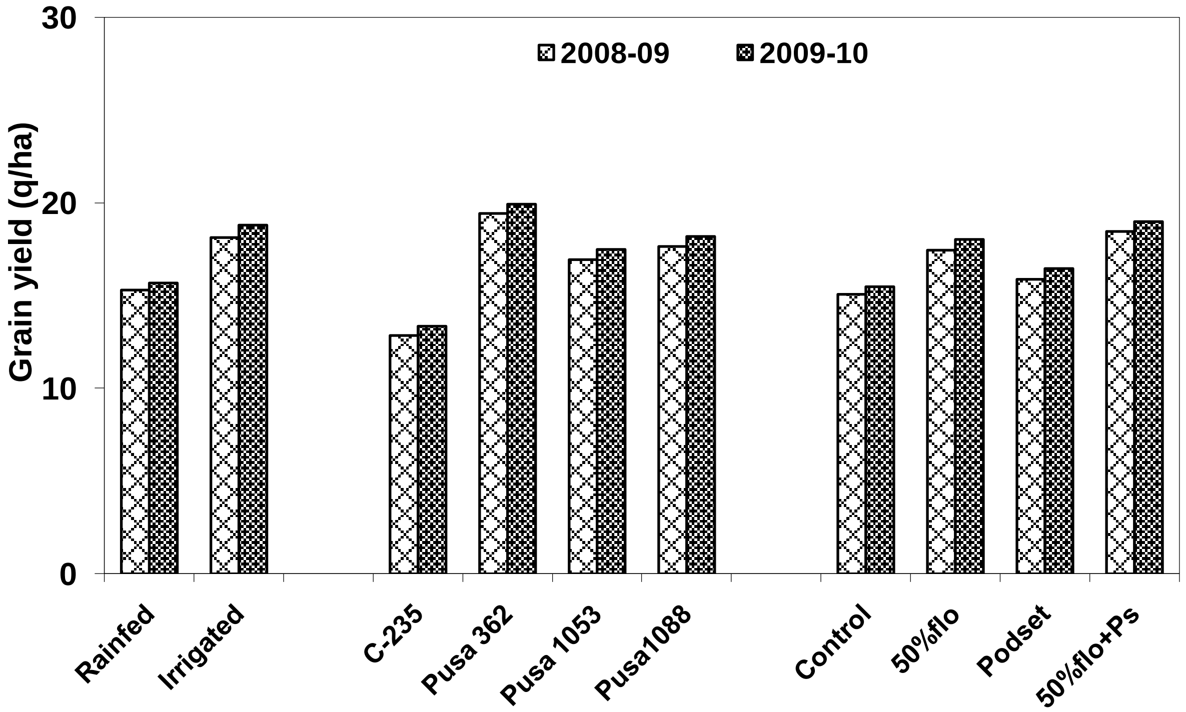


Fig 3. Biomass/plant and Biological yield q/h of chickpea genotypes as influenced by foliar application of urea (2%) at different stages under rainfed and irrigated conditions



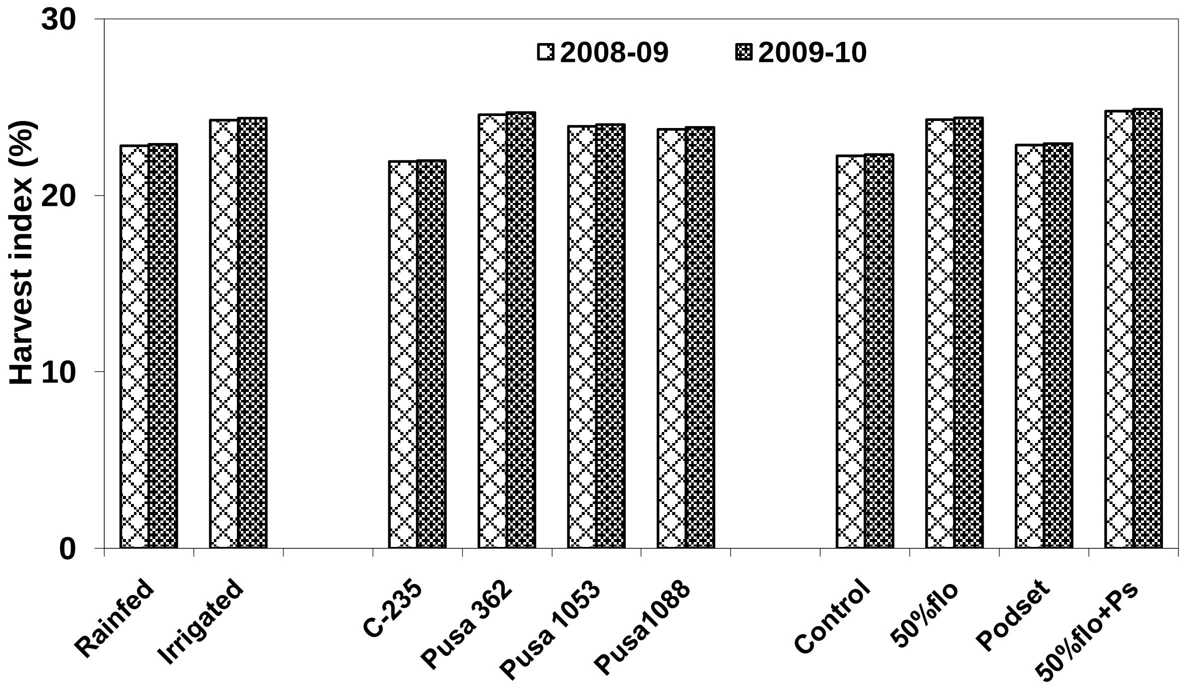


Fig 4. Grain yield q/h and harvest index (%) of chickpea genotypes as influenced by foliar application of urea (2%) at different stages under rainfed and irrigated conditions.

REFERENCES

Ali, M. and Kumar, S. (2007) Mile stone in Food Legume Research pp: 249-289.

Bahr, A.A. (2007). Effect of plant density and urea foliar application on yield and yield components of chickpea (*Cicer arietinum* L.). *Res. J. Agric. Biol. Sci.;* 3(4): 220-223.

Behairy, T.G., Saad A.O., and Kabesh, M.O (1988) Increasing Broad Bean (*Vicia foba* L.)Yield by Early and Late Nitrogen Fertilization. Egypt j. Agron. 13(1-2): 137-145.

Bray. E. A. (1993). Molecular Responses to Water Deficit Plant Physiol. **103**: 1035- 1040

Dhonde, S.R., Deshmukh, D.V. and Jamadagni, B.M. (2006). Effect of water stress on assimilates partitioning in component parts of chickpea. *Ann. Pl. Physiol.,* 20(2): 181-185.

Durga, K.K., Rao, Y.K. and Reddy, M.V. (2005). Performance of chickpea genotypes under irrigated and unirrigated conditions. *Legume Res.,* 28(3): 226-228.

El Krammy MF, Magda H, Mohamed and Nofal OA. (2003). Effect of late foliar application with urea and potassium fertilization on yield, yield components and chemical composition of two mungbean varieties. Egyptian Journal of Applied Sciences 18: 177-188.

Guhey, A. and Trivedi, A.K. (2001). Dry matter accumulation and partitioning in chickpea under two moisture regimes. *Madras Agril. J.,* 88: 484-486.

Kumar, S., Kumar, R., Malik, V. and Kadian, V.S. (2008). Effect of sowing dates on chickpea cultivars under irrigated conditions of south-west Haryana. *Haryana J. Agron.,* 24(1/2): 9-11.

Leport, L., Turner, N.C., Davies, S.L. and Siddique, K.H.M. (2006). Variation in pod production and abortion among chickpea cultivars under terminal drought. *Eur. J. Agron.,* 24: 236–246.

Leport, L., Turner, N.C., French, R.J., Barr, M.D. Duda, R. Davies, S.L. Tennant, D. and Siddique, K.H.M. (1999). Physiological responses of chickpea genotypes to terminal drought in a Mediterranean-type environment. *European J. Agron.,* 11(3/4): 279-291.

Mansur, C.P. Palled, Y.B. Halikatti, S.I., Chetti, M.B. and Salimath, P.M. (2010). Effect of dates of sowing and irrigation levels on biometric growth parameters of *Kabuli* chickpea. *Karnataka J. Agril. Sci.,* 23(4): 566-569

Palta, J.A., Nandwal, A.S., Kumari, S. and Turner, N.C. (2005). Foliar nitrogen applications increase the seed yield and protein content in chickpea (*Cicer arietinum* L.) subject to terminal drought. *Australian J. Agril. Res.,* 56(2): 105-112.

Saman , Maryam, Ali Sepehri , Gudarz Ahmadvand , Seyed Hosein Sabaghpour (2010). Effect of Terminal Drought on Yield and Yield Components of Five Chickpea Genotypes Iranian Journal of Field Crop Science 41: 25-41.

Singh, T.P., Deshmukh, P.S., Srivastava, G.C., Kushwaha, S.R. and Mishra S.K. (2005). Growth rate of chickpea (*Cicer arietinum* L.) genotypes under different planting dates. *Indian J. Plant Physiol.,* 10(3): NS: 254-259.

Singh, T.P., Deshmukh, P.S. and Kushwaha, S.R. (2007). Response of different sowing dates on seed protein content and productivity of chickpea (*Cicer arietinum* L.) genotypes. *Indian J. Agric. Sci.,* 77(9): 607-608.

Sheoran, P., Sardana, V. and Singh, S. (2008). Effect of sowing dates and seed rates on productivity of chickpea cultivars under dryland conditions in Shiwalik foothills of Punjab. J. *Food Legumes,* **21**(1): 43-45.

Upadhyaya, H.D., Dronavalli, N., Gowda, C.L.L. and Singh, S. (2011). Identification and evaluation of chickpea germplasm for tolerance to heat stress. *Crop Sci.,* 51(5): 2079-2094.

Zaman-Allah, Mainassara Jenkinson, D.M. and Vadez, V. (2011). Chickpea genotypes contrasting for seed yield under terminal drought stress in the field differ for traits related to the control of water use. *Functional Plant Biology,* 38(4): 270-281.

Zeidan, M.S. (2003). Effect of sowing dates and urea foliar application on growth and seed yield of determinate faba bean (*vicia faba* L.) under Egyptian conditions Egypt j. Agronomy 24: 93-102.