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Resource management in cowpea (*Vigna unguiculata* L. Walp.) for yield maximization under rainfed conditions

K. C. GUPTA AND R. SAXENA

Division of Agronomy
Rajasthan Agricultural Research Institute
SKNAU, Jobner, Durgapura, Jaipur, Rajasthan

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ABSTRACT

Field experiments was conducted for three consecutive kharif seasons of 2011, 2012 and 2013 at Rajasthan Agricultural Research Institute, Durgapura, Jaipur to study the effect of resource management in cowpea for yield maximization under rainfed conditions. Results of three years pooled data revealed that foliar application of urea either @ 1% or @ 2% and mulching @ 3 t ha^{-1} at 25-30 DAS of crop significantly increased yield attributes (pods plant^{-1}, seeds pod^{-1} and seed index) and seed yield of cowpea. Foliar application of 2% urea recorded maximum values of yield attributes, seed yield, net returns (ha^{-1}) and B:C ratio. The significant increase in pods plant^{-1}, seeds pod^{-1} and seed index due to foliar application of 2% urea were 7.64 and 16.34, 4.38 and 9.30 and 5.23 and 6.23 per cent respectively over normal planting and control. Further, the maximum value of pooled grain yield (9.26 q ha^{-1}), net returns (21892 ha^{-1}) and B:C ratio (1.77) were recorded under foliar application of 2 % urea while the least were observed under control (5.47 q ha^{-1}, 9299 ha^{-1} and 0.85).

Keywords: Cowpea, resource management, yield and B: C ratio

Cowpea (*Vigna unguiculata* L. Walp.), an annual legume, is also commonly referred to as southern pea, black eye pea, crowder pea *etc*. It is chiefly used as green pod as vegetable, while it's '*dal*' is used for various delicious preparations. Its straw is a valuable fodder for milch cattle. Besides these, the cowpea crop fully covers the ground which checks soil erosion and water loss from the field. These qualities make it an ideal component of diversified cropping systems especially in Rajasthan. However, the average yield of cowpea in Rajasthan state is only 529 kg ha^{-1} (Rajasthan Agricultural Statistics at a glance, 2011-12), which is low with wide variation with year. Erratic rainfall, drought, high temperatures, high evapotranspirational losses of water, poor fertility and inter and intra plant competition are the major constraints restricting the yield of cowpea particularly in Rajasthan. Keeping in view, the present experiment was conducted to study resource management in cowpea for yield maximization under rainfed conditions.

MATERIALS AND METHODS

The field experiment was carried out at research farm of Rajasthan Agricultural Research Institute, Durgapura, Jaipur (Rajasthan) during *kharif* seasons of 2011 to 2013. Durgapura is situated in the eastern part of Rajasthan and lies between 26^{0}51' North latitude and 75^{0}47'east longitude and at an elevation of 390 m. It falls under semi arid climatic conditions, which is characterized by the features of hot dry summers and cool dry winters. The annual rainfall ranges from 500-600 mm., which is often erratic and ill-distributed along with an occasional long dry spells or frequent heavy rainy days during rainy season. The mean daily maximum temperature ranges from 22.0 to 40.6 ^{0}C and daily minimum temperature ranges from 8.3 ^{0}C to 27.3 ^{0}C. The relative humidity varies from season to season. It ranges between 80 to 95% during rainy season, which goes upto 100% and 20 to 30% during winter and summer seasons, respectively. The soil type of the experimental field was loamy sand with sand (87.7 %), silt (5.6%), clay (7.7%), 8.3 pH, 0.24% organic carbon and 143.3, 33.0, and 223.6 kg ha^{-1} available N, P_2O_5 and K_2O respectively. The present investigation was comprised of 9 treatment combinations consisting with different resource management *viz.* T_1 – Normal sowing, T_2 - Reducing 25 % population by increasing inter row spacing, T_3 – Foliar spray of 1 % urea at 25-30 DAS, T_4 – Foliar spray of 2% urea at 25-30 DAS, T_5 – Foliar spray of antitranspirant (kaolin 5 %) at 25-30 DAS, T_6 – Foliar spray of growth retardant (MH 1 %) at 25-30 DAS, T_7 – mulching (plant origin) @ 3 t ha^{-1}, T_8 – PSB inoculation and T_9 – control. The experiment was laid out in a randomized block design with four replications. The crop was sown with the onset of monsoon during each years of experimentation and raised strictly as rainfed. Variety RC-101 was used for sowing. A basal dose of 15 kg N, 40 kg P_2O_5 ha^{-1} was applied to every treatment except for control (T_9) and PSB inoculation (T_8).

Email: mathurrani@rediffmail.com

Table 1: Resource management in cowpea for yield maximization under rainfed conditions

Treatments	Pods plant^{-1}				Seeds pod^{-1}				Seed Index (g)				Seed yield (q ha^{-1})				Net returns (ha^{-1})	B:C ratio
	2011	2012	2013	Pooled	2011	2012	2013	Pooled	2011	2012	2013	Pooled	2011	2012	2013	Pooled		
T_1	5.79	6.02	6.25	6.02	7.72	8.26	8.68	8.22	10.16	10.74	11.20	10.70	4.88	7.08	7.30	6.42	11754	0.98
T_2	6.02	6.18	6.46	6.22	8.38	8.44	8.50	8.44	11.00	11.07	11.14	11.07	4.98	7.22	6.99	6.36	11532	0.96
T_3	6.25	6.27	6.50	6.34	8.44	8.46	8.54	8.48	11.10	11.16	11.22	11.16	6.15	10.14	9.74	8.68	19766	1.60
T_4	5.96	6.43	7.05	6.48	8.54	8.59	8.61	8.58	11.20	11.24	11.34	11.26	7.28	10.56	9.95	9.26	21892	1.77
T_5	5.94	5.96	6.22	6.04	8.29	8.30	8.37	8.32	10.72	10.78	10.84	10.78	4.89	8.06	8.26	7.07	13659	1.09
T_6	6.02	6.14	6.20	6.04	8.20	8.27	8.31	8.26	10.90	10.99	11.02	10.97	5.00	8.82	8.36	7.39	14743	1.17
T_7	6.13	6.26	6.27	6.12	8.36	8.40	8.44	8.40	10.99	11.05	11.08	11.04	7.50	8.96	9.31	8.59	18583	1.41
T_8	5.65	5.85	5.9	5.80	7.98	8.05	8.09	8.04	10.59	10.65	10.68	10.64	4.66	6.67	7.52	6.28	12246	1.11
T_9	5.24	5.70	5.78	5.57	7.52	7.98	8.06	7.85	10.12	10.58	11.10	10.60	4.29	6.18	5.93	5.47	9299	0.85
SEm (±)	**0.12**	**0.10**	**0.08**	**0.15**	**0.10**	**0.10**	**0.08**	**0.11**	**0.14**	**0.12**	**0.11**	**0.15**	**0.47**	**0.26**	**0.47**	**0.29**		
LSD (0.05)	**0.36**	**0.29**	**0.24**	**0.46**	**0.31**	**0.29**	**0.25**	**0.34**	**0.42**	**0.37**	**0.33**	**0.44**	**1.41**	**0.77**	**1.40**	**0.88**		

Note: T_1– Normal planting, T_2 -Reducing 25 % population by increasing inter row spacing, T_3– Foliar spray of 1 % urea at 25-30 DAS , T_4– Foliar spray of 2% urea, T_5 - Foliar spray of antitranspirant (kaolin 5 %), T_6 - Foliar spray of growth retardent (MH 1 %), T_7- mulching @ 3 t ha^{-1}, T_8– PSB inoculation and T_9– control, Sale price of cowpea @ 3700 q^{-1}, Cost of cultivation for T_1– 12000 , T_2 - 12000, T_3– 12350, T_4– 12370, T_5- 12500, T_6 - 12600, T_7- 13200, T_8– 10990 and T_9– 10940

RESULTS AND DISCUSSION

Results revealed that foliar application of urea and mulching @ 3 t ha^{-1} at 25-30 DAS had significantly influenced on yield attributes (pods $plant^{-1}$, seeds pod^{-1} and seed index) and seed yield of cowpea. The maximum pods $plant^{-1}$ (6.48), seeds pod^{-1} (8.58) and seed index (11.26 g) was recorded under foliar application of 2% urea at 25-30 DAS closely followed by foliar application of 1% urea and mulching @ 3 t ha^{-1} but was significantly superior over normal sowing, seed inoculation with PSB and control.

The increase in pod $plant^{-1}$, seeds pod^{-1} and seed index due to foliar application of 2% urea were 7.64 and 16.34, 4.38 and 9.30 and 5.23 and 6.23 per cent respectively over normal planting (T_1) and control (T_9). The enhancement in yield attributes under foliar application of urea could be ascribed to role of nitrogen in promoting the manufacture of food but also its subsequent portioning in sink. Similar findings were also reported by Rajendran (1991) in green gram and Dwivedi and Tiwari (1991) in chickpea. Similarly, foliar application of 2% urea recorded highest seed yield during all the three years of experimentation and were significantly at par seed yield under foliar application of 1% urea. Similar findings were also reported by Pujari *et al*. (1998) in pigeonpea. However, the response of mulching varies year wise depending upon the rainfall pattern and total rainfall. On the basis of pooled data, the maximum seed yield (9.26 q ha^{-1}) was recorded under foliar application of 2% urea at 25-30 DAS which was statistically at par under foliar application of 1% urea (8.68 q ha^{-1}) and mulching @ 3 t ha^{-1} (8.59 q ha^{-1}) and all the above three were significantly superior over rest of the treatments. Further, the maximum net returns (**'**21892 ha^{-1}) and B:C ratio of 1.77 was also recorded under foliar application of 2% urea while the least were observed under control (**'**9299 ha^{-1} and 0.85). The significant increase in seed yield under foliar application of 2% urea might be due to the fact that the foliar applied nutrients are more effective, higher uptake efficiency and foliar supply of nutrients can increase photosynthetic efficiency by delaying the leaf senescence as compared to soil applied nutrients. The increase in pods $plant^{-1}$, seeds pod^{-1} and seed index under foliar application could led to significant increase in seed yield of cowpea. Similar findings were also reported by Devi *et al.* (2011) in wheat, Ganapathy *et al.* (2008) in rice fallow pulses, Anadhakrishnaveni *et al.* (2004) in green gram and Jeyakumar *et al.* (2008) in blackgram.

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