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RESEARCH PAPER

Effect of irrigation and levels of fertilizers application on growth and yield of zero tilled cowpea (*Vigna unguiculata* L.)

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Abstract : A Field experiment was conducted at Agronomy farm of Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli during *Rabi* season of 2011-2012 to study the effect of irrigation and levels of fertilizer application zero tilled cowpea. After harvesting of rice, cowpea was sown on zero tilled condition. Results revealed that application of two irrigations (at branching and pod filling) recorded significantly higher growth and yield attributes resulting in higher grain (12.26 q ha^{-1}) and stover (26.17 q ha^{-1}) yield followed by treatments in which one irrigation (at branching) and zero irrigation (control). Application of 100 per cent RDF below seed placement recorded significantly higher growth as well as yield attributes resulted in higher grain (12.62 q ha^{-1}) and stover yield (26.48 q ha^{-1}) followed by 100 per cent RDF through line application, 75, 50, 25 per cent RDF below seed placement and control. Thus, the study revealed that during *Rabi* hot weather season cowpea crop grown under zero tilled condition should be provided with two irrigations (at branching and pod filling stage) along with 100 per cent recommended dose of fertilizer (25:50:00 NPK kg ha^{-1}) applied below seed placement for obtaining higher yield.

Key Words : Irrigation, Fertilizer, Zero tilled cowpea

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INTRODUCTION

Pulses are nature's precious gift to mankind. Cowpea (*Vigna unguiculata* L.) is a broadly adapted and highly variable crop, cultivated around the world primarily as a pulse but also as a vegetable, a cover crop and for fodder. In *konkan* region of Maharashtra, pulses are mainly grown in *Rabi* season in rice field after harvest of rice crop both on residual moisture as well as under irrigation. The cultivation of cowpea in rice fallows is reported to be more profitable than horse gram and mustard (Kadrekar, 1990). The average productivity of pulses in konkan found to be very low. Among various pulses, which are liked and relished by konkan people is cowpea. The reasons for the low yield of cowpea grown on residual moisture in zero tilled condition are that cowpea hardly receives any irrigation at critical growth stages during hot weather. Another cause for low yield of cowpea is lack of suitable method and level of fertilizer application to crop grown on residual moisture. Therefore, to exploit high yielding potential of cowpea on residual moisture field experiment was conducted.

MATERIAL AND METHODS

A Field experiment was conducted at Department of Agronomy, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during *Rabi* season of 2011-2012 to study the effect of irrigation and levels of fertilizer application on zero tilled cowpea. The experiment was laid out in a Split Plot Design with three replications. The main plot treatments were three irrigation levels, *viz.*, no irrigation (I_0), one irrigation at

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branching (I_1) and two irrigations at branching and pod filling stage (I_2). The sub plot treatments comprised of six fertilizer levels *viz.*, no fertilizer (F_0), 25 per cent RDF below seed placement (F_1), 50 per cent RDF below seed placement (F_2), 75 per cent RDF below seed placement (F_3), 100 per cent RDF below seed placement (F_4) and 100 per cent RDF through line application (F_5). Thus, there were in all 18 treatment combinations. The treatments were randomized in the experimental units. The experimental plot was left unploughed and was uniform in topography. The plots of 4.2 m × 3.3 m size were prepared and demarked manually. Under zero tillage condition, the fertilizers were applied uniformly to the whole plot in the holes dibbled earlier at the spacing of 30 x 15 cm. Whole quantity of fertilizers (25:50 kg NP ha^{-1}) was uniformly mixed and it was applied 3-4 cm below the seed to avoid the direct contact of seed with fertilizers. The calculated quantity of N and P_2O_5 was applied through urea and single super phosphate, respectively. After fertilizer application the seeds were sown in the holes dibbled. Two to three seeds were dibbled at each spot at about 5 cm depth. Seeds were properly covered with the soil to avoid the damage from birds. In the present investigation, irrigations were applied as per treatments at branching and pod filling stage to the respective plots, for that purpose irrigations were given to respective treatment plots by flexi pipe, as small bunds were raised around each respective plot. In order to assess the effect of different treatments on the growth and yield of cowpea crop biometrical observations were recorded.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect on growth :

Irrigation levels :

Growth attributes increased significantly with increase in the irrigation level (Table 1). Treatment I_2 recorded maximum growth attributes *viz.*, plant height (17.50 cm), number of leaves per plant (10.65), number of branches per plant (6.29), spread of plant (24.09 cm) and dry matter production per plant (7.26 g) which was significantly superior over treatments I_1 and I_0. However, treatment I_1 was found significantly superior over treatment I_0. Treatment I_0 recorded significantly the lowest plant height (14.05 cm), number of leaves per plant (8.62), number of branches per plant (5.07), spread of plant (20.43 cm) and dry matter production per plant (3.56 g) than rest of the treatments. The increase in growth attributes was mainly attributed due to availability of irrigations at these two critical growth stages of cowpea. Two irrigations at critical stages of the crop resulted in very good cell turgidity there by increasing the cell elongation resulting in taller plants. Similar increase in growth characters under application of irrigation at branching

Table 1: Effect of irrigation and fertilizer levels on growth of cowpea

Treatments	Plant height (cm)	No. of leaves	No. of branches	Mean spread (cm)	Dry matter (g)
Irrigation levels					
I_0: Control	14.05	8.62	5.07	20.43	3.56
I_1: One irrigation (At branching)	15.83	9.54	6.14	23.82	6.28
I_2: Two irrigation (At branching and pod filling)	17.50	10.65	6.29	24.09	7.26
S.E. ±	0.38	0.13	0.13	0.18	0.23
C.D. (P=0.05)	1.49	0.50	0.52	0.70	0.89
Fertilizer levels					
F_0: Control	12.69	7.79	4.49	18.20	3.54
F_1: 25% RDF below seed placement.	13.84	8.46	5.09	20.49	4.39
F_2: 50% RDF below seed placement.	14.98	9.24	5.67	22.36	5.27
F_3: 75% RDF below seed placement.	16.82	10.03	6.11	23.82	6.11
F_4: 100% RDF below seed placement.	18.63	11.31	6.96	26.51	7.72
F_5: 100% RDF through line application	17.78	10.79	6.69	25.31	7.14
S.E. ±	0.31	0.24	0.24	0.16	0.28
C.D. (P=0.05)	0.89	0.69	0.71	0.47	0.81
Interaction effect					
S.E. ±	0.54	0.41	0.12	0.27	0.48
C.D. (P=0.05)	NS	NS	NS	NS	NS
General mean	15.79	9.60	5.83	22.78	5.70

NS = Non-significant

stage and pod development stage was observed by Reddy and Ahlawat (1998), Singh *et al*. (2004) and Asaduzzaman *et al*. (2008).

Fertilizer levels :

Data in Table 1 revealed that treatment F_4 recorded the highest growth attributes such as plant height (18.63 cm), number of leaves per plant (11.31), number of branches per plant (6.96) and dry matter production per plant (7.72 g) of cowpea followed by treatment F_5 which were at par with each other but found significantly superior over treatment F_3, F_2, F_1 and F_0 in that descending order of significance. Mean spread of plant was influenced significantly due to various fertilizer levels under study. Treatment F_4 recorded significantly more plant spread than rest of the treatments *viz.*, F_5, F_3, F_2, F_1 and F_0 in that descending order of significance. Treatment F_0 recorded significantly minimum spread of plant as compared to other fertilizer levels under study. After supplying ample amount of N, P_2O_5 and K_2O as in case of F_4 and F_5 contributed probably higher chlorophyll content which enables the crops photosynthetically more active and, therefore, higher dry matter accumulation which has reflected in recording of superior values of growth parameters as plant height (cm), number of leaves, number of branches, plant spread (cm) and dry matter accumulation (g) followed by treatments F_3, F_2, F_1 and F_0. These results are in line with those reported by Baboo and Mishra (2001) and Borse *et al*. (2002). Interaction effect was non significant.

Effect on yield:

Irrigation levels :

The data (Table 2) on yield attributes revealed that, application of two irrigations at branching and pod filling stages significantly improved all the yield attributing characters like number of pods per plant (11.28), number of grains per pod (10.78), length of pod (11.28 cm), grain (12.26 q ha^{-1}) and stover yield (26.17 q ha^{-1}) followed by one irrigation at branching and control. The possible reason of high yield attributing characters may be traced due to the increased dry matter production might have resulted in greater synthesis of photosynthates contributing to an increase in yield attributes. The beneficial effect of application of irrigation resulted in improved yield attributes was also be noticed by Borse *et al.* (2002) and Shersingh *et al.* (2004).

The grain yield was found to be increased by 65.23 % over control due to application of two irrigations at branching and pod filling *i.e.* treatment I_2. The increase in grain and straw yield in treatment I_2 was mainly attributed due to higher moisture availability due to two irrigations at the critical growth stages (branching and pod filling) of cowpea. Increase in grain

Table 2: Effect of irrigation and fertilizer levels on yield attributes and yield of cowpea

Treatments	No. of pods $plant^{-1}$	No. of grains pod^{-1}	Length of pod (cm)	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})
Irrigation levels					
I_0: Control	7.48	8.19	9.87	7.42	16.41
I_1: One irrigation (At branching)	8.98	9.87	10.49	10.00	21.21
I_2: Two irrigation (At branching and pod filling)	11.28	10.78	11.28	12.26	26.17
S.E. ±	0.19	0.17	0.15	0.37	0.65
C.D. (P=0.05)	0.77	0.65	0.58	1.45	2.56
Fertilizer levels					
F_0: Control	6.93	8.29	8.96	6.67	15.20
F_1: 25% RDF below seed placement.	7.89	8.82	9.60	8.09	17.56
F_2: 50% RDF below seed placement.	8.93	9.40	10.38	9.70	20.46
F_3: 75% RDF below seed placement.	9.82	10.02	11.13	10.93	22.71
F_4: 100% RDF below seed placement.	11.42	10.91	11.91	12.62	26.48
F_5: 100% RDF through line application	10.47	10.23	11.29	11.36	25.17
S.Em. ±	0.29	0.19	0.19	0.41	0.75
C.D. (P=0.05)	0.86	0.55	0.55	1.18	2.17
Interaction effect					
S.E. ±	0.52	0.33	0.33	0.71	1.30
C.D. (P=0.05)	NS	NS	NS	NS	NS
General mean	9.24	9.61	10.50	9.89	21.26

NS=Non-significant

and straw yield due to cumulative effect of better growth attributes resulted in better partitioning of photosynthesis in yield attributes and finally produced maximum yield contributing parameters in terms of grain.

Fertilizer levels :

Glimpses of data presented in Table 2 showed that, treatment F_4 recorded the highest number of pods per plant (11.42), number of grains per pod (10.91), length of pod (11.91 cm), grain (12.62 q ha^{-1}) and stover yield (26.48 q ha^{-1}) followed by treatment F_5 which were at par with each other but significantly superior over treatments F_3, F_2, F_1 and F_0 in that descending order of significance. Availability of optimum amount of essential plant nutrients resulted in a production of superior yield attributes. The plant nutrients are most important for growth and development of crops. These results conoborates the findings of Reddy and Ahlawat (1998) and Baboo and Mishra (2001). Interaction effect was non-significant.

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