Research Article

Response of Cowpea (*Vigna Unguiculata* L) To Foliar Application of Different Organic Sources and Levels of Fertilizer

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Abstract

The field experiment entitled "Influence of foliar application of different organic sources on growth, yield and quality of cowpea (*Vigna unguiculata* L.) under varying levels of fertilizers" was conducted at Agronomy Farm, College of Agriculture, Dapoli, Dist. Ratnagiri (M.S.) during *Rabi* 2019-20. The field experiment was laid out in Factorial Randomized block design. The fertilizer levels comprised of three levels *viz.*, F_1: 100% RDF, F_2: 75% RDF and F_3: 50% RDF and foliar application consisted of five different organic sources *viz.*, S_0: Control, S_1: Panchagavya @ 3%, S_2: Vermiwash @ 10%, S_3: Cow urine @ 5% and S_4: Vasant urja @ 0.5%. There were 15 treatment combinations replicated three times. From the results, it can be concluded that for growing cowpea, it should be supplied with 100% RDF and sprayed with panchagavya @ 3% or cow urine @ 5% foliar application, so as to obtain higher yield and quality of cowpea by improving soil fertility status.

Keywords: Cow pea, Economics, Fertilizer levels, Growth attributes, Organic sources, Quality, Yield attributes and Yield

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Introduction

Cowpea (*Vigna unguiculata* L.) is used in many parts of the world for its high-protein seeds, but also for its nutrient-rich edible leaves, forage, and soil enrichment. It also contains carbohydrates (56.8%), fibre (3.9%), ash (3.20%) and fat (1.3%). Cowpea is generally more heat-tolerant than common bean. Cowpeas are one of the most important food legume crops in the semi-arid tropics that cover Asia, Africa, southern Europe and Central and South America. A drought-tolerant and warm-weather crop, cowpeas are well-adapted to the drier regions of the tropics, where other food legumes do not perform as well. It also has the useful ability to fix atmospheric nitrogen through its root nodules, and it grows well in poor soils. Between 2010 and 2013, 173 different countries grew and exported pulses. At triennium ending 2010-11, the total area under pulses was 723 lakh ha. This area provided about 644.08 lakh tonnes of pulses with a productivity of 890 kg ha^{-1}. The highest area was contributed by India (32.24%) followed by Niger (7), Myanmar (5.33), Brazil (5.29) and Nigeria (4.44). Similarly, the contribution to total production by India was 23.46%, Canada 7.93, China 7.09, Myanmar 6.89 and Brazil 5.29. The highest productivity was of France (4219 kg ha^{-1}) followed by Canada (1936), USA (1882), Russian Federation (1643) and China (1596), whereas in the same period, the productivity of India was 648 kg ha^{-1} [1]. Productivity of cowpea in our country is very low. So, there is need to take proper agronomic practices to enhance the productivity of cowpea and foremost important among them is foliar application of organic and inorganic sources of nutrients exploiting genetic potential of crop. This is considered to be an efficient and economic method of supplementing part of nutrient requirement at critical growth stages of the crop. Foliar application is credited with the advantage of quick and efficient utilization of nutrients, elimination of losses through leaching, fixation and regulating uptake of nutrients by the plant. Since foliar nutrients usually penetrate the leaf cuticle or stomata and enters the cell facilitating easy and rapid utilization of nutrients. So foliar nutrition on cowpea helps in achieving the optimum grain yield of cowpea.

For any crop, fertilizer is the most critical input for utilizing the yield potential of improved high yielding crop varieties. The value of growing legume in sustaining and improving soil fertility has been known since long. However, in recent days i.e. post green revolution era, due to indiscriminate nutrient mining, soil fertility is depleting at an alarming rate and to provide food for nearly 125 crores human population, there is need to add fertilizers to augment the sustainable crop production. In view of above consideration, the experiment entitled "Influence of foliar application of different organic sources on growth, yield and quality of cowpea (*Vigna unguiculata* L.) under varying levels of fertilizer" was conducted during *Rabi* 2019-20 with objectives to study the effect of different levels of fertilizer on yield and quality of cowpea, to study the effect of foliar application of different organic sources on yield

and quality of cowpea and to study the interaction effect of different levels of fertilizer and foliar application of organic sources.

Materials and Methods

The field experiment entitled "Influence of foliar application of different organic sources on growth, yield and quality of cowpea (*Vigna unguiculata* L.) under varying levels of fertilizers" was conducted at Agronomy Farm, College of Agriculture, Dapoli, Dist. Ratnagiri (M.S.) during *Rabi* 2019-20. The soil of the experimental plot was sandy clay loam in texture, slightly acidic in pH (5.80) and high in organic carbon content (15.6 g kg^{-1}). Soil was medium in available nitrogen (257.15 kg ha^{-1}), low in available phosphorus (15.81kg ha^{-1}) and high in available potassium (246.73kg ha^{-1}). The field experiment was laid out in Factorial Randomized block design. The fertilizer comprised of three levels *viz.,* F_1: 100% RDF, F_2: 75% RDF and F_3: 50% RDF and foliar application consisted of five different organic sources *viz.*, S_0: Control, S_1: Panchagavya @ 3%, S_2: Vermiwash @ 10%, S_3: Cow urine @ 5% and S_4: Vasant urja @ 0.5%. There were 15 treatment combinations replicated three times. The cowpea cultivar "Konkan safed" was sown with seeds treatment of Rhizobium culture @ 250 g 10 kg^{-1} of seeds before sowing. The dibbling of seeds was done with spacing of 30 cm between two rows and 10 cm plant to plant. The crop was fertilized with recommended dose 25 kg N and 50 kg P_2O_5. At the time of sowing Nitrogen was supplied through urea having (46% N) while phosphorous supplied through single super phosphate (16% P_2O_5) which was applied along the marked lines (i.e. line placement) 5 cm below the soil surface in the moist zone and then covered properly. Foliar spray of panchagavya (3%), vermiwash (10%), cow urine (5%) and vasant urja (0.5%) were given at 35 and 45 days after sowing. First irrigation was given immediately after sowing for proper germination and another irrigations were given at branching, flowering and pod development stage at 10-15 days interval. For the control of aphids, jassids and thrips, Dimethoate 30% EC 10 ml 10 lit^{-1} water were sprayed at 30 days of crop stage. Cowpea was harvested in four pickings. Pods were picked when pods started drying on the plants. The picking of pods was done at 8-10 days interval. The harvested pods were kept 2-3 days for sun drying. The straw was harvested and kept for sun drying.

Results and Discussion

Effect of levels of fertilizer

The treatment receiving 100% RDF in respect of length of pod, number of pods $plant^{-1}$, number of seeds pod^{-1} and 100 seed weight (g) was significantly superior over 75% and 50% RDF. Thus, 100% RDF recorded significantly higher grain yield ha^{-1} over rest of fertilizer levels. The increased yield attributes might be due to increased growth and development parameters which ultimately resulted in increased grain yield. The present results were in consonance with those of [2] and [3].

The higher stover yield was recorded by the treatment receiving 100% RDF in cowpea which was found significantly superior over 75% and 50% RDF. This might be due to increased morphological characters *viz.,* plant height (cm), number of leaves $plant^{-1}$, number of branches $plant^{-1}$, leaf area $plant^{-1}$ and dry matter $plant^{-1}$ observed under 100% RDF. Similar findings were also reported by [4]. Thus, the results clearly showed that 100% RDF was superior which was followed by 75% and 50% RDF for obtaining higher grain and stover yield ha^{-1} from cowpea.

The protein content of cowpea followed the same trend as nitrogen content by grain and stover because protein content was computed by multiplying N content with the factor of 6.25. Protein content in grain and stover was the highest in case of 100% RDF which was more than 75% RDF and 50% RDF.

The treatment receiving 100% RDF recorded almost identical and higher N, P and K content in grain and stover of cowpea. This might be due to the fact that the crop absorbed proportionately higher amount of N, P and K due to their higher availability due to application and which are favorable for plant growth.

The uptake of N, P and K recorded maximum in 100% RDF which was significantly superior over 75% and 50%. Since uptake is a function of grain and stover yield and their nutrient content, the significant improvement in the content of these nutrients coupled with increased grain and stover yield increased the uptake of nutrients substantially. These results corroborates the findings of [5] and [6].

The available N, P and K content of soil after harvest of cowpea were influenced significantly due to different fertilizer levels. The soil available N, P and K after harvest of cowpea were maximum and significantly higher by 100% RDF as compared to 75% and 50%. The net available soil N, P and K balance negative under all treatment combination.

Table 1 Grain yield q ha^{-1}, stover yield q ha^{-1}, Protein content (%) and Protein yield (Kg ha^{-1}) of cowpea as influenced by different treatments

Treatments	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Protein content (%)	Protein yield (Kgha^{-1})
Fertilizer levels				
F_1:100% RDF	17.31	33.19	21.11	366.71
F_2: 75% RDF	14.85	28.95	20.32	302.18
F_3: 50% RDF)	12.79	26.39	19.88	254.55
S.E.±	0.23	0.21	0.20	5.43
C.D. at 5%	0.66	0.61	0.57	15.73
Organic Sources (Foliar application)				
S_1: Panchagavya @ 3%	17.61	31.36	20.83	368.60
S_2: Vermiwash @ 10%	16.46	30.15	20.14	332.31
S_3: Cow urine @ 5%	15.03	29.51	21.66	326.79
S_4: Vasant urja @ 0.5%	13.72	29.09	19.98	274.92
S_0: Control	12.08	27.43	19.57	236.45
S.E.±	0.29	0.27	0.25	7.01
C.D. at 5%	0.85	0.79	0.73	20.30
Interaction effect				
S.E.±	0.51	0.47	0.44	12.14
C.D. at 5%	NS	NS	NS	NS
General Mean	14.98	29.51	20.44	307.81

Table 2 Nitrogen, phosphorous and potassium content in grain and stover (%), nitrogen,phosporous and potassium uptake by grain and stover and total uptake (kg ha^{-1}) by cowpea as influenced by different treatments.

Treatments	Nitrogen content (%)		Nitrogen uptake (kg ha^{-1})			Phosphorous content (%)		Phosphorous uptake (kg ha-1)			Potassium Content (%)		Potassium uptake (kg ha^{-1})		
	Grain	Stover	Grain	Stover	Total	Grain	Stover	Grain	Stover	Total	Grain	Stover	Grain	Stover	Total
Fertilizer levels															
F_1:100% RDF	3.38	1.58	58.67	52.77	111.45	0.339	0.209	5.89	6.97	12.86	1.57	2.30	27.44	76.35	103.80
F_2: 75% RDF	3.25	1.47	48.35	42.63	90.98	0.334	0.188	4.96	5.46	10.42	1.33	2.08	19.90	60.35	80.25
F_3: 50% RDF)	3.18	1.28	40.73	33.93	74.66	0.323	0.163	4.13	4.33	8.46	1.27	1.93	16.42	51.05	67.47
S.E.±	0.03	0.04	0.87	1.23	1.41	0.002	0.003	0.07	0.11	0.13	0.04	0.02	0.67	0.69	1.05
C.D. at 5%	0.09	0.12	2.52	3.57	4.08	0.005	0.010	0.21	0.32	0.37	0.12	0.05	1.95	2.00	3.03
Organic Sources (Foliar application)															
S_1: Panchagavya @ 3%	3.33	1.54	58.98	48.67	107.65	0.320	0.217	6.04	6.84	12.88	1.55	2.22	27.38	70.02	97.40
S_2: Vermiwash @ 10%	3.22	1.49	53.17	45.26	98.43	0.333	0.181	5.50	5.52	11.02	1.40	2.08	23.31	63.26	86.57
S_3: Cow urine @ 5%	3.47	1.59	52.29	47.26	99.55	0.336	0.198	5.06	5.90	10.96	1.46	2.18	22.26	64.70	86.97
S_4: Vasant urja @ 0.5%	3.20	1.40	43.99	40.96	84.94	0.329	0.176	4.51	5.19	9.70	1.31	2.05	18.13	60.18	78.31
S_0: Control	3.13	1.21	37.83	33.41	71.24	0.320	0.161	3.87	4.47	8.34	1.24	1.98	15.19	54.75	69.94
S.E.±	0.04	0.05	1.12	1.59	1.82	0.002	0.004	0.09	0.14	0.16	0.05	0.02	0.87	0.89	1.35
C.D. at 5%	0.12	0.15	3.25	4.61	5.27	0.007	0.013	0.27	0.41	0.47	0.15	0.07	2.52	2.58	3.91
Interaction effect															
S.E.±	0.07	0.09	1.94	2.75	3.15	0.004	0.008	0.16	0.25	0.28	0.09	0.04	1.51	1.54	2.34
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General Mean	3.27	1.44	49.25	43.11	92.36	0.332	0.187	5.00	5.58	10.58	1.39	2.10	21.25	62.59	83.84

Effect of organic sources

Application of panchagavya @ 3% recorded maximum and significantly higher grain yield over rest of the treatments. The mean increase in grain yield recorded under the application of panchagavya @ 3% over vermiwash @ 10%, cow urine @ 5%, vasant urja @ 0.5% and control. The increase in grain yield of cowpea due to application of panchagavya @ 3% may be accounted for significant improvement in yield attributes *viz.*, length of pod, number of pods plant^{-1}, number of seeds pod^{-1} and 100 seed weight (g) which finally resulted in increased grain yield. The findings were analogous with the results reported by [7].

The stover yield of cowpea followed the similar trend like grain yield. The significant increase in stover yield recorded under panchagavya @ 3% over vermiwash @ 10%, cow urine @ 5%, vasant urja @ 0.5% and control, respectively. The increase in stover yield could be attributed to increase in growth characters like plant height, number of leaves plant^{-1}, number of branches plant^{-1}, dry matter plant^{-1} and finally stover yield due to application of panchagavya @ 3%. These results were in line with those reported by [8] and [9].

The protein content of cowpea grain and stover increased significantly under the application of panchagavya @ 3% over rest of treatments. This increase in protein content could be attributed to increased concentration of nitrogen in grain and straw of cowpea under different organic sources which augmented the synthesis of proteins and their content in grain and stover of cowpea. The results of the experiment following the reported results of [9].

The data revealed that application of panchagavya @ 3% to cowpea recorded significantly higher N, P and K content in grain and straw over rest of the treatments. These findings corroborate the reports of [10]. The application of panchagavya @ 3% recorded the highest uptake of nitrogen, phosphorous and potassium by cowpea grain, stover as well as total uptake compared to rest of the treatments. The increased uptake of these nutrients by cowpea was due to increase in grain and stover yield and N, P and K content of grain and stover under the different organic sources. These results are similar to those reported by [11] and [12].

The net available soil N, P_2O_5 and K_2O balance were found to be negative under all the organic sources due to slow releasing properties.

Table 3 Available NPK (kg ha^{-1}) influenced by different treatments

Treatments	**Available N (Kg ha^{-1})**	**Available P_2O_5 (Kg ha^{-1})**	**Available K_2O (Kg ha^{-1})**
Fertilizer levels			
F_1:100% RDF	216.25	14.71	219.71
F_2: 75% RDF	212.41	12.02	194.64
F_3: 50% RDF)	193.67	10.86	162.89
S.E.±	4.62	0.12	1.92
C.D. at 5%	13.39	0.36	5.56
Organic Sources (Foliar application)			
S_1: Panchagavya @ 3%	231.91	14.11	215.24
S_2: Vermiwash @ 10%	216.32	12.97	201.44
S_3: Cow urine @ 5%	202.93	12.68	190.85
S_4: Vasant urja @ 0.5%	196.52	11.61	180.47
S_0: Control	189.55	11.28	174.06
S.E.±	5.97	0.16	2.48
C.D. at 5%	17.28	0.46	7.18
Interaction effect			
S.E.±	10.34	0.27	4.29
C.D. at 5%	NS	NS	NS
General Mean	207.45	12.53	192.41
Initial	257.15	15.81	246.73

Interaction effects between various fertilizer levels and organic sources treatments

The Grain yield q ha^{-1}, stover yield q ha^{-1}, Protein content (%), Protein yield (Kg ha^{-1}), Nitrogen, phosphorous and potassium content in grain and stover (%), nitrogen uptake by grain and stover and total nitrogen uptake (kg ha^{-1}) and available NPK (kg ha^{-1}) were not markedly influenced by interaction effects of different fertilizer levels and organic sources treatments application.

Conclusion

From the results , it can be concluded that for growing cowpea, it should be supplied with 100% RDF and sprayed with panchagavya @ 3% or cow urine @ 5% foliar application, so as to obtain higher yield and quality of cowpea by improving soil fertility status.

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