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Improving Growth and Productivity of Cowpea under Different Nutrient Management Practices

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ABSTRACT

Field experiments were conducted to improve the growth and productivity of cowpea through different nutrient management practices at Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University during March to May, 2018 and at farmer's field, Minnampalli Village, Manmangalam Taluk, Karur District during September to December, 2018. The experiments were laid out in randomized block design (RBD) with three replications comprising of 10 treatments viz. T_1: control, T_2: 100% recommended dose of nitrogen (RDN) through fertilizer [25 kg Nitrogen], T_3: 50% RDN through fertilizer + 50% N through Vermicompost, T_4: 50% RDN through fertilizer + 50% N through FYM, T_5: 100% RDN through fertilizer + 0.5% $ZnSO_4$ foliar spray (30 and 45 Days After Sowing), T_6: 50% RDN through fertilizer + 50% N through Vermicompost + 0.5% $ZnSO_4$ foliar spray (30 and 45 DAS), T_7: 50% RDN through fertilizer + 50% N through FYM + 0.5% $ZnSO_4$ foliar spray (30 and 45 DAS), T_8: 100% RDN through fertilizer + 0.5% Zn-EDTA foliar spray (30 and 45 DAS), T_9: 50% RDN through fertilizer + 50% N through Vermicompost + 0.5% Zn-EDTA foliar spray (30 and 45 DAS) and T_{10}: 50% RDN through fertilizer + 50% N through FYM + 0.5% Zn-EDTA foliar spray (30 and 45 DAS). The result of the study revealed that application of 50% RDN + 50% N through Vermicompost + 0.5% Zn-EDTA foliar spray on 30 and 45 DAS showed a significant increment in the growth characters viz. Plant height, leaf area index and dry matter production, yield attributes viz. number of branches plant^{-1}, pod length and number of pods plant^{-1} and yield of cowpea over the control.

***Key words*:** FYM, Nitrogen, Vermicompost, Zn-EDTA, $ZnSO_4$

Cowpea (*Vigna unguiculata*) is often referred as the vegetable meat as it is a significant source of dietary protein, minerals and vitamins for the poor people who have limited access to protein from animal sources viz., meat and fish. It is an important multipurpose legume crop in the tropics and subtropics, endowed with several unique characteristics. Cowpea is a leguminous crop it has the capacity to fix atmospheric nitrogen through symbiotic nitrogen fixation. After picking of pods, cowpea plants may be used as green fodder or as green manure.

The productivity of pulses is low due to cultivation on marginal and sub marginal lands under poor management. So, it needs earnest attention in adoption of desirable production technologies to exploit the yield potential of the pulses and it can be possible by application of organic manures, fertilizers and foliar application of nutrients. Integrated Nutrient Management (INM) is basically the complementary use of organic, inorganic and biological sources of plant nutrients to maintain and sustain soil fertility and enhance crop productivity in a framework of an ecologically compatible, socially acceptable and economically viable situation. Nitrogen plays an important role in various metabolic process of the plant growth. Nitrogen is an essential constituent of protein and chlorophyll [1]. Organic manures like farm yard manure and compost have been traditionally used as input for improving soil physical, chemical and biological properties as well as maintain soil fertility which has resulted in yield stability.

In India, zinc (Zn) is now considered as fourth most important yield limiting nutrient in agricultural crops. Zinc deficiency in Indian soils is likely to increase from 49 to 63% by 2025. Among the micronutrients, zinc plays a vital role in plant growth and development. Zn is involved in a number of physiological processes of plant growth metabolism including enzyme activation, protein synthesis, metabolism of carbohydrates, lipids, auxins and nucleic acids, gene expression, regulation and reproductive development (pollen formation) [2-3]. Its deficiency retards photosynthesis and nitrogen metabolism. Keeping in view of

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this situation, a study was conducted to evaluate the synergistic effect of the integrated nutrient management system involving the use of organic manures and fertilizer nitrogen on the growth and yield of cowpea.

MATERIALS AND METHODS

Field experiments were conducted to improve the growth and productivity of cowpea through different nutrient management practices at Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University during March to May, 2018 and at farmer's field, Minnampalli Village, Manmangalam Taluk, Karur District during September to December, 2018. The soils of the experimental farm and farmer's field are clay loam and red sandy loam in texture with pH of 7.06 and 7.4, organic carbon of 0.60% and 0.44%, available nitrogen of 217 kg ha^{-1} and 185 kg ha^{-1}, available phosphorus of 18 kg ha^{-1} and 15 kg ha^{-1} and available potassium of 296 kg ha^{-1} and 335 kg ha^{-1}, respectively. The experiments were laid out in randomoized block design with 10 treatments and replicated thrice. Treatments comprised T_1 - control, T_2 - 100% RDN [25 kg N], T_3 - 50% RDN + 50% N through Vermicompost, T_4 - 50% RDN + 50% N through FYM, T_5 - 100% RDN + 0.5% $ZnSO_4$ foliar spray (30 and 45 DAS), T_6 - 50% RDN + 50% N through Vermicompost + 0.5% $ZnSO_4$ foliar spray (30 and 45 DAS), T_7 - 50% RDN + 50% N through FYM + 0.5% $ZnSO_4$ foliar spray (30 and 45 DAS), T_8 - 100% RDN + 0.5% Zn-EDTA foliar spray (30 and 45 DAS), T_9 - 50% RDN + 50% N through Vermicompost + 0.5% Zn-EDTA foliar spray (30 and 45 DAS) and T_{10} - 50% RDN + 50% N through FYM + 0.5% Zn-EDTA foliar spray (30 and 45 DAS). Recommended dose of fertilizer is 25: 50: 25 kg of N, P_2O_5 and K_2O ha^{-1}. For T_3, T_6 and T_9 treatments N is supplied through vermicompost which contain 1.85% N, 0.71% P, 1.48% K at the rate of 676 kg ha^{-1} and for T_4, T_7 and T_{10} treatments 50% N is supplied through FYM which contain 0.53% N, 0.32% P, 0.52% K at the rate of 2359 kg ha^{-1}, remaining 50% N supplied through urea (46%). Single super phosphate (16%P_2O_5) and Muriate of potash (60% K_2O) fertilizers were used to supply P and K nutrients, respectively. All the fertilizers were applied basally. Five plants in each plot were selected at random in border rows and tagged. These plants were used for recording all biometric observation at different stages of crop growth. The average number of pods per plant and length of pods were counted. After threshing and winnowing the weight of seeds for each net plot area was recorded in kg per plot and then converted in kg ha^{-1}. The experimental data were statistically analyzed [4]. For significant results, the critical difference was worked out at 5 per cent probability level.

RESULTS AND DISCUSSION

Effect on growth characters

All the treatments had significant effect on plant height, leaf area index (LAI) and Dry matter production (DMP) over control. The result of the field experiment on cowpea revealed that the growth characters were conspicuously influenced by the application of 50% RDN + 50% N through Vermicompost + 0.5% Zn-EDTA foliar spray on 30 and 45 DAS registered the maximum values of plant height (58.87 and 62.24 cm), LAI (3.43 and 3.82), DMP (4783 and 5197 kg ha^{-1}) in both the locations. Improvement in growth attributes due to application of inorganic fertilizer enhanced the availability of nutrients especially nitrogen which is mainly responsible for vegetative growth and phosphorus which plays an important role in the root development and increased nodule activity in plant [5-7]. Leaf area was significantly increased by nitrogen, possibly because nitrogen helps in greater assimilation of food material by the plant which resulted in greater meristematic activities of cells and consequently the number of leaves, length and width of leaf of plant [8]. Positive effect of foliar application of Zn on an enhanced branching in pulses is mainly attributed to promotion of bud and branch development by the auxins whereas Zn application ultimately increased the availability of other nutrients and accelerated the translocation of photo assimilates [9].

Table 1 Effect of integrated nutrient management on growth characters of cowpea

Treatments	Plant height (cm)				Leaf area index		Dry matter production (kg ha^{-1})			
	45 DAS		Harvest		45 DAS		45 DAS		Harvest	
	First crop	Second crop	First crop	Second crop	First crop	Second crop	First crop	Second crop	First crop	Second crop
T_1	31.65	33.07	35.60	37.74	1.96	2.02	1324	1400	2385	2539
T_2	33.46	34.99	38.31	40.55	2.15	2.23	1866	1972	2983	3171
T_3	36.90	38.68	43.55	45.98	2.47	2.60	2103	2291	3434	3711
T_4	35.15	36.86	41.00	43.29	2.32	2.43	1969	2148	3200	3450
T_5	38.61	40.57	46.16	48.69	2.65	2.83	2212	2430	3638	3959
T_6	43.69	46.13	53.75	56.86	3.12	3.42	2590	2818	4324	4680
T_7	42.04	44.22	51.27	54.08	2.95	3.24	2482	2708	4120	4456
T_8	40.35	42.36	48.70	51.44	2.81	3.02	2341	2557	3871	4198
T_9	47.10	49.78	58.87	62.24	3.43	3.82	2841	3114	4783	5197
T_{10}	45.42	47.96	56.34	59.52	3.27	3.63	2702	2980	4540	4952
S.Ed	0.76	0.83	1.15	1.24	0.06	0.08	46.29	49.58	88.26	95.85
CD (P=0.05)	1.60	1.75	2.43	2.60	0.12	0.16	97.26	104.18	185.44	201.31

Effect on yield attributes

Application of organic and inorganic manures along with zinc resulted in significantly higher yield attributes viz., number of branches plant^{-1} (7.12 and 7.94), pod length (17.07 and 18.65 cm) and number of pods plant^{-1} (19.24 and 21.67) in both the crops. This might be due to higher concentration of macro and micro nutrients in the organic manure which has attributed to higher rate of N mineralization as a result of high cation exchange capacity, slow and gradual release of N could make the soil more productive over a longer period, thus enhanced the number of pods plant^{-1}. The constant release of N from organic manure supplemented with N fertilizer accelerates the development of growth and reproductive phases thus promoting pod length and number of pods [10]. Application of vermicompost increased the root extension, thus helped in greater uptake of nutrients which ultimately improved the yield attributing characters like pod length, pod yield, number of pods plant^{-1} and number of seeds pod^{-1} [11]. Zinc application to crops enhanced the nutrient metabolism, biological activity and growth parameters and hence, applied zinc resulted in higher enzyme activity which in turn encourage vegetative branches and pods plant^{-1} [12].

Table 2 Effect of integrated nutrient management on yield attributes and yield of cowpea

Treatments	Number of branches plant^{-1}		Number of pods plant^{-1}		Pod length (cm)		Seed yield (kg ha^{-1})		Haulm yield (kg ha^{-1})	
	First crop	Second crop	First crop	Second crop	First crop	Second crop	First crop	Second crop	First crop	Second crop
T_1	4.23	4.70	12.00	13.81	11.27	12.31	793	902	2014	2258
T_2	4.60	5.14	12.82	14.71	11.99	13.08	1004	1145	2371	2597
T_3	5.20	5.86	14.39	16.42	13.24	14.41	1168	1315	2728	2954
T_4	4.92	5.52	13.62	15.53	12.60	13.72	1083	1232	2546	2782
T_5	5.58	6.27	15.23	17.26	13.91	15.21	1240	1410	2885	3128
T_6	6.52	7.26	17.69	19.95	15.83	17.31	1488	1665	3375	3668
T_7	6.23	6.97	16.83	19.04	15.12	16.56	1419	1587	3240	3506
T_8	5.92	6.64	16.01	18.19	14.49	15.92	1327	1495	3075	3305
T_9	7.12	7.94	19.24	21.67	17.07	18.65	1647	1834	3656	4016
T_{10}	6.85	7.62	18.45	20.83	16.42	17.96	1565	1746	3512	3834
S.Ed	0.11	0.13	0.34	0.38	0.27	0.29	30.67	34.64	61.38	71.00
CD (P=0.05)	0.23	0.26	0.72	0.79	0.56	0.61	64.44	72.78	128.96	149.18

Effect on yield

Among the various treatment imposed in the study, application of 50% RDN + 50% N through Vermicompost + 0.5% Zn-EDTA foliar spray on 30 and 45 DAS significantly increased the seed yield (1647 and 1834 kg ha^{-1} in first and second crop, respectively) and haulm yield (3656 and 4016 kg ha^{-1} in first and second crop, respectively). This was due to the application of N through inorganic fertilizer and vermicompost that offered a balanced nutritional release pattern to plants, provided nutrients such as available N, soluble K, exchangeable Ca, Mg and P that could be taken readily by plants [13]. The cumulative effect of growth parameters, yield attributes and higher nutrient uptake by cowpea increased the seed yield [14]. The application of organic and inorganic nutrient along with zinc foliar spray resulted in steady and higher availability of major, secondary and micronutrients during the crop growth period which have enhanced the growth and yield attributes and finally augmented to better seed yield. The result corroborates the finding of [15].

CONCLUSION

Integrated nutrient management practices ensure the soil health and protect the environment in sustainable way. Application of 50% RDN + 50% N through Vermicompost + 0.5% Zn-EDTA foliar spray on 30 and 45 DAS enhanced the growth, yield attributes and yield. Therefore, this practice is found to be agronomically sound and economically viable practice, thereby ensuring long term sustainability of soil health and can be recommended for realizing better yield and returns.

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