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Effects of integrated nutrient management on yield attributes, yield and nutrient uptake of cowpea

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Abstract
Field experiments were conducted to improve the 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 yield attributes, yield and nutrient uptake of cowpea.

Keywords: FYM, nitrogen, vermicompost, Zn-EDTA, $ZnSO_4$

Introduction
Pulses are the major sources of proteins among the vegetarians in India. Cowpea is often referred as the vegetable meat as it is a most important source of dietary protein, minerals and vitamins. Maintaining food and nutritional security for the increasing population of the world is a great challenge, because the demand of pulses is increasing due to increasing population. The productivity of pulses is declining year by year due to many reasons. To meet the demand, cowpea productivity need to be increased. The productivity of pulse crop 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 chemical fertilizers, organic manures and foliar application of nutrients. Nitrogen plays an important role in various metabolic process of the plant growth. Nitrogen is an essential constituent of protein and chlorophyll (Meena and Chand, 2014) [7]. Organic manures like farmyard 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. 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} (Joshi *et al.*, 2016). Among the micronutrients, zinc plays an important role in plant growth and development. Application of zinc increased the number of branches, flowering of cowpea and recorded higher yield attributes and yield (Mona El-Azab, 2016 and Deepanshu *et al.*, 2017) [9, 3]. Foliar nutrition is accepted as an important method because it facilitates easy and rapid utilization of nutrients (Thakur *et al.*, 2017) [10].

Materials and Methods
Field experiments were conducted to improve the 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, 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 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 fertilizers were applied to the experimental fields as per the recommended manurial schedule of 25: 50: 25 kg of N, P_2O_5 and K_2O ha^{-1}. Urea (46% N), Single super phosphate (16% P_2O_5) and Muriate of potash (60% K_2O) fertilizers were used to supply N, P and K nutrients, respectively. Chemical nitrogen dose was decreased as per the treatment schedule. 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.

Results and Discussion

Yield attributes and Yield (Table 1)

The yield attributes *viz.,* number of branches plant^{-1}, pod length, number of pods plant^{-1} and seed yield were significantly influenced by the application organic manures, inorganic nitrogen and zinc. The maximum number of branches plant^{-1} (7.12 and 7.94), pod length (17.07 and 18.65 cm), number of pods plant^{-1} (19.24 and 21.67) and seed yield (1647 and 1834 kg ha^{-1}) in both the crops were significantly registered with 50% RDN through fertilizer + 50% N through Vermicompost + 0.5% Zn-EDTA foliar spray (30 and 45 DAS) (T_9). This might be due to higher concentration of macro and micronutrients 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 (Kaviraja *et al.,* 2017) [6]. 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} (Johi *et al.,* 2016) [4]. 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} (Michail *et al.,* 2004) [8]. The cumulative effect of growth parameters, yield attributes and higher nutrient uptake by cowpea increased the seed yield (Channabasappa *et al.,* 2004) [2].

Table 1: Effect of integrated nutrient management on yield attributes and yield (kg ha^{-1}) in cowpea

Treatments	Number of branches plant^{-1}		pod length (cm)		Number of pods plant^{-1}		Number of seeds pod^{-1}		Seed 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	11.27	12.31	12.00	13.81	8.05	8.80	793	902
T_2	4.60	5.14	11.99	13.08	12.82	14.71	8.70	9.51	1004	1145
T_3	5.20	5.86	13.24	14.41	14.39	16.42	9.79	10.69	1168	1315
T_4	4.92	5.52	12.60	13.72	13.62	15.53	9.26	10.16	1083	1232
T_5	5.58	6.27	13.91	15.21	15.23	17.26	10.40	11.26	1240	1410
T_6	6.52	7.26	15.83	17.31	17.69	19.95	12.05	13.11	1488	1665
T_7	6.23	6.97	15.12	16.56	16.83	19.04	11.46	12.48	1419	1587
T_8	5.92	6.64	14.49	15.92	16.01	18.19	10.97	11.93	1327	1495
T_9	7.12	7.94	17.07	18.65	19.24	21.67	13.12	14.24	1647	1834
T_{10}	6.85	7.62	16.42	17.96	18.45	20.83	12.56	13.65	1565	1746
S.Ed	0.11	0.13	0.27	0.29	0.34	0.38	0.21	0.22	30.67	34.64
CD (P = 0.05)	0.23	0.26	0.56	0.61	0.72	0.79	0.44	0.47	64.44	72.78

Nutrient uptake (Table 2)

The data on the effect of different integrated nutrient management practices showed that the application of 50% RDN through fertilizer + 50% N through Vermicompost + 0.5% Zn-EDTA foliar spray (30 and 45 DAS) (T_9) recorded higher NPK uptake at harvest stage of cowpea. Better growth of plants resulting in higher dry matter production and higher nitrogen concentration in plants due to better absorption of nitrogen by cowpea could be the reason for such a positive trend. Application of vermicompost could have resulted in steady supply of nitrogen due to faster decomposition and mineralization and made available to the plants at critical stages of crop growth. Zinc had significant influence on the concentration and uptake as they plays important role in growth and development (Anil Kumar Singh *et al.,* 2012).

Table 2: Effect of integrated nutrient management on NPK uptake (kg ha^{-1}) in cowpea

Treatments	First crop			Second crop		
	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
T_1	55.15	7.92	54.04	57.77	8.47	55.95
T_2	59.25	8.55	57.22	62.05	9.21	59.06
T_3	66.03	9.73	63.07	68.94	10.63	65.01
T_4	62.86	9.10	60.23	65.77	9.91	62.07
T_5	69.44	10.31	66.13	72.30	11.31	67.96
T_6	78.90	12.13	75.12	81.88	13.37	77.13
T_7	75.94	11.52	72.15	78.78	12.68	74.03
T_8	72.73	10.93	69.11	75.57	11.97	70.94
T_9	85.12	13.24	81.07	88.49	14.69	83.21
T_{10}	81.94	12.70	78.06	85.30	14.02	80.14
S.Ed	1.38	0.24	1.31	1.43	0.29	1.37
CD (P = 0.05)	2.89	0.50	2.75	3.01	0.61	2.87

Conclusion

The application of nitrogen through chemical fertilizer along with vermicompost and zinc registered the maximum values of yield attributes, seed yield and nutrient uptake of cowpea. Based on the results of the present study, application of 50% RDN through fertilizer + 50% N through Vermicompost + 0.5% Zn-EDTA foliar spray (30 and 45 DAS) was found to be more effective for utilization of nutrients, improving crop performance and productivity.

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