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Effect of integrated Nutrient Management practices on physiological and yield traits of Maize (*Zea mays* L.) + Cowpea (*Vigna unguiculata* L.) intercropping system in Northwestern agro climatic zones of Tamil Nadu

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Abstract

Unbalanced use of chemical fertilizers were causing serious problem in Northwestern agro climatic zones of Tamil Nadu. Proper nutrient management and cropping systems are essential to maximize the production and sustain agricultural production while minimizing the negative impacts of soil fertility. The aim of the present study was to investigate the suitable nutrient management practices for the maize + cowpea intercropping system in Northwestern Agro climatic zones of Tamil Nadu. The field experiment was conducted at Ramarkoodal village, Dharmapuri, Tamil Nadu during *Rabi* 2020. This experiment was laid out in Randomized Block Design (RBD) with three replications. There were altogether twelve treatments *viz.,* T_1 - 100 % RDF (135:62.5:50 kg NPK ha^{-1}) + FYM at 12.5t/ha, T_2– 100% RDF NPK ha^{-1}+ Bio compost @ 12.5t ha^{-1}, T_3–100% RDF NPK ha^{-1}+ Vermicompost @ 5t ha^{-1}, T_4 - 75% RDF NPK ha^{-1}+ FYM @ 12.5t ha^{-1}+Maize maxim, T_5–75% RDF NPK ha^{-1}+ Bio compost @ 12.5t/ha +Maize maxim, T_6 - 75% RDF NPK/ha + Vermicompost @5t ha^{-1}+ Maize maxim, T_7-75% RDF NPK ha^{-1}+ FYM @ 12.5t ha^{-1}+Panchagavya at 3%, T_8–75 % RDF NPK ha^{-1}+ Bio compost @ 12.5t ha^{-1}+ Panchagavya @ 3%, T_9 –75% RDF NPK ha^{-1}+ Vermicompost @ 5t ha^{-1}+ Panchagavya @ 3%, T_{10}- 50% RDF NPK ha^{-1}+ FYM @ 12.5t ha^{-1}+Maize maxim +Panchagavya @ 3%, T_{11}-50% RDF NPK ha^{-1}+ Bio compost @ 12.5t ha^{-1}+Maize maxim +Panchagavya at 3% and T_{12}- 50% RDF NPK ha^{-1}+Vermicompost @ 5t/ha+ Maize maxim +Panchgavya @ 3%. The result indicated that the highest growth characters were recorded in T_{12}- means application of 50% RDF NPK ha^{-1} and Vermicompost @ 5t ha^{-1} along with foliar spray of Maize maxim 7.5kg ha^{-1} and Panchgavya @3% during tassel initiation and grain filling stage might be an appropriate integrated nutrient management practices on growth and yield of maize with due care on soil fertility.

Maize (*Zea mays* L.) is an annual C_4 plant belonging to the grassy family Poaceae, with its origin in Central America. Among the maize growing countries India ranks 4^{th} place in area and 7^{th} place in production. It occupies around 4 percent of world maize area and 2 percent of total production. During 2018-19 in India, the maize cultivated area has reached to 9.2 M ha (DACNET, 2020). In India, maize is cultivated in an area of 8.67 M ha with a production of 21.73 MT with a productivity of 2.54 t ha^{-1}. In Tamilnadu, it is cultivated in an area of 0.39 million hectares with production of 2.83 million tonnes and a productivity of 7.2 t ha^{-1} and also it occupies fourth position in Indian maize production (Tamilnadu Agriculture Department policy note, 2019-2020).

Maize, in general being a heavy feeder crop, Maize requires much more nutrients than compared to other crops and in order to meet those nutritional requirements the farmers are applying large quantities of inorganic fertilizers without understanding its negative impact in the fertility status of the soil as well as the concerned environment. However, continuously growing of a same crop over years in the same cultivated area leads to ill health of the soil, increases various pest and diseases and decline in productivity that can overcome by following alternate methods such as intercropping, relay cropping and mixed cropping. Introducing of grain legume in cereal based cropping system aims at increased productivity and profitability to achieve food and nutritional security and sustainability[10]. Maize is a tall growing and wide spaced crop provides sufficient inter row space, which can be profitably utilized for raising short duration and short statured remunerative crops, such as intercrops for providing sustainable yield and additional income to the maize farmers. Intercropping is one of the potential cropping systems to exploit valuable resources like light, moisture and nutrients more efficiently than a mono cropping. Cropping system involving legumes and cereals together in the same field offers the possibility of yield advantages for both component crops[5].

Plants derive nutrients from soil, which is inadequate to meet the ever increasing demand for higher production. Improper nutrition leading to nutrient imbalance in soil, which is a key factor contributing to lower production. Nutrient management helps in maintenance of soil fertility and plant nutrient supply at an optimum level for sustainable crop productivity through optimization of benefit derived from all possible sources of plant nutrients *viz.,* organic, inorganic and biological components in an integrated manner. And intercropping is widely accepted as a sustainable practice due to its yield advantage, high utilization efficiency of light, water and pest and diseases suppression[13]. Among different maize based cropping system, maize-cowpea is emerging as potential maize based cropping system in India. This cropping system practices increased, because of its value addition in food and it fits well in the intercropping system compare to green gram[4]. Thus, intercropping improves the utilization of available researches, root yield advantages and increases yield stability. Considering the above mentioned reason, this study was carried out to find out the effects of maize based intercropping as influenced by integrated nutrient management on growth and yield attributes of maize.

The field experiment was conducted at Ramarkoodal village, Dharmapuri, Tamilnadu, India. during Rabi season 2020. The experimental site is situated at 12°05' N latitude and 78° 00' E longitude at an altitude of 468 m above Mean Sea Level. This experiment was laid out in Randomized Block Design (RBD) with three replications. This experiment was laid out in Randomized Block Design (RBD) with three replications. There were altogether twelve treatments *viz.,* T_1 - 100 % RDF (135:62.5:50 kg NPK ha^{-1}) + FYM at 12.5t/ ha, T_2 – 100% RDF NPK ha^{-1}+ Bio compost @ 12.5t ha^{-1}, T_3 –100% RDF NPK ha^{-1}+ Vermicompost @ 5t ha^{-1}, T_4 - 75% RDF NPK ha^{-1}+ FYM @ 12.5t ha^{-1}+Maize maxim, T_5 – 75% RDF NPK ha^{-1}+ Bio compost @ 12.5t/ ha +Maize maxim, T_6 - 75% RDF NPK/ha + Vermicompost @5t ha^{-1}+ Maize maxim,T_7 - 75% RDF NPK ha^{-1}+ FYM @ 12.5t ha^{-1} +Panchagavya at 3%, T_8 –75 % RDF NPK ha^{-1}+ Bio compost @ 12.5t ha^{-1}+ Panchagavya @ 3%, T_9–75% RDF NPK ha^{-1}+ Vermicompost @ 5t ha^{-1}+ Panchagavya @ 3%,T_{10}- 50% RDF NPK ha^{-1}+ FYM @ 12.5t ha^{-1}+Maize maxim +Panchagavya @ 3%, T_{11}-50% RDF NPK ha^{-1}+ Bio compost @ 12.5t ha^{-1}+Maize maxim +Panchagavya at 3% and T_{12}- 50% RDF NPK ha^{-1}+Vermicompost @ 5t/ha+ Maize maxim +Panchgavya @ 3%. The aim of the present study was to investigate the right source of nutrient management practices for the maize and cowpea intercropping system in Northwestern agro climatic zones of Tamilnadu. The experimental soil is clay loam and the fertility status was low in available nitrogen, medium in available Phosphorous and medium in available potassium. Maize (CO H6) and Cowpea (CO 6) were used as the test variety of this experiment and the seeds were obtained from the Tamilnadu Agricultural University, Coimbatore, Tamilnadu, India. Maize intercropped with cowpea as an additive series at (1: 1) planting ratio was followed. The spacing of maize and cowpea are 60 X 25cm and 30 X 15 cm respectively. The cowpea seeds were sown in between the each pair of rows. All the cultural practices and plant protection measures for the maize were followed as per the recommendations of the crop production guide of Agricultural crops in Tamilnadu.

The organic nutrient sources which have been used were biocompost, vermicompost, farmyard manure, panchagavya, maize maxim and biofertilizers.

***Panchagavya preparation**:* Panchagavya was prepared by the method suggested by Raghavendra *et al.* (2014).; Panchagavya was prepared by using the five by-products of cow along with few other ingredients. Panchagavya has the potential to play the role of promoting growth and providing immunity in plant system. The ingredients used for preparation of panchagavya are, Fresh cow dung (5 kg) Cow urine (3 liters), Cow curd (2 liters), milk (2 liters), Cow ghee (1 liter), Tender coconut water (3 liters), Sugarcane juice (3 liters) and Ripened banana (1 kg). Cow dung was mixed with all other ingredients at once in the plastic container having a capacity of 20 liters, ripped bananas were also added to facilitate faster fermentation. All the materials were put into a wide mounted mud pot and kept open under shade. The contents were stirred for about 20 minutes, both in the

Table1. Influence of nutrient management on plant height, leaf area index, dry matter production and yield attributes of maize

Treat-ments	Pl.ht			LAI		DMP			yield attributes			
	30 DAS	60 DAS	Har-vest	30 DAS	60 DAS	30 DAS	60 DAS	Harvest	Cob length	No. Grains cob^{-1}	Grain Yield ha^{-1}	Stover Yield t ha^{-1}
T_1	84.21	197.06	203.09	3.21	5.09	4227	6507	8410	14.84	396	6834	7679
T_2	85.36	197.3	203.3	3.24	5.17	4274	6568	8481	14.98	400	6909	7753
T_3	99.56	224.14	236.56	4.38	6.6	4985	7621	9976	17.59	476	8218	8962
T_4	90.34	207.34	214.31	3.58	5.61	4519	6909	9028	16.32	423	7372	8167
T_5	92.14	208.79	216.45	3.7	5.73	4584	6984	9141	16.48	434	7414	8201
T_6	99.86	229.8	242.02	4.62	6.74	5089	7746	10215	17.94	496	8349	9020
T_7	93.84	210.34	218.34	3.81	5.88	4609	7045	9209	16.62	441	7435	8217
T_8	98.65	222.31	232.14	4.25	6.44	4952	7586	9923	17.56	468	8090	8824
T_9	104.33	240.36	254.69	5.01	7.22	5341	8098	10765	18.82	520	8774	9384
T_{10}	94.26	211.28	220.28	3.88	6.01	4669	7199	9376	16.68	446	7685	8457
T_{11}	99.72	226.47	240.9	4.51	6.66	5045	7697	10056	17.79	482	8335	9011
T_{12}	104.7	242.54	256.79	5.06	7.38	5356	8117	10813	19.01	536	8836	9416
S.Ed	**1.55**	**3.52**	**3.85**	**0.11**	**0.15**	**85.82**	**120.21**	**177.66**	0.29	7.59	138.26	128.73
CD(p=0.05)	**4.38**	**9.94**	**10.86**	**0.32**	**0.41**	**242**	**339**	**501**	0.82	21.39	389.89	363.01

T_1 - 100 % RDF (135:62.5:50 kg NPK ha^{-1}) + FYM at 12.5t/ha, T_2– 100% RDF NPK ha^{-1}+ Bio compost @ 12.5t ha^{-1}, T_3–100% RDF NPK ha^{-1}+ Vermicompost @ 5t ha^{-1}, T_4 - 75% RDF NPK ha^{-1}+ FYM @ 12.5t ha^{-1}+Maize maxim, T_5–75% RDF NPK ha^{-1}+ Bio compost @ 12.5t/ha +Maize maxim,T_6 - 75% RDF NPK/ha + Vermicompost @5t ha^{-1}+ Maize maxim,T_7 -75% RDF NPK ha^{-1}+ FYM @ 12.5t ha^{-1} +Panchagavya at 3%, T_8–75 % RDF NPK ha^{-1}+ Bio compost @ 12.5t ha^{-1}+ Panchagavya @ 3%, T_9–75% RDF NPK ha^{-1}+ Vermicompost @ 5t ha^{-1}+ Panchagavya @ 3%, T_{10}- 50% RDF NPK ha^{-1}+ FYM @ 12.5t ha^{-1}+Maize maxim +Panchagavya @ 3%, T_{11}-50% RDF NPK ha^{-1}+ Bio compost @ 12.5 t ha^{-1}+Maize maxim +Panchagavya at 3% and T_{12}- 50% RDF NPK ha^{-1}+Vermicompost @5t/ha+ Maize maxim +Panchgavya @ 3%

morning and evening to facilitate aerobic microbial growth, aeration and to increase the storability period up to two months. After 10 days, the Panchagavya stock solution was ready for use. From the stock solution 3 per cent concentration was prepared according to the requirement (To get 3% concentration, 3 litres of Panchagavya were mixed with 100 litres of water). The spray solution @ 500 litres ha-1 was applied using hand sprayer with high pore size.

Biocompost : was prepared by using Coimbatore method. In **Coimbatore method**, composting is done in pits of different sizes depending on the waste material available. A layer of waste materials is first laid in the pit. It is moistened with a suspension of 5-10 kg cow dung in 2.5 to 5.0 I of water and 0.5 to 1.0 kg fine bone meal sprinkled over it uniformly. Similar layers are laid one over the other till the material rises 0.75 m above the ground level. It is finally plastered with wet mud and left undisturbed for 8 to 10 weeks. Plaster is then removed, material moistened with water, given a turning and made into a rectangular heap under a shade. It is left undisturbed till its use

Maize maxim is a tonic with nutrients and growth regulators of maize. It was developed by TNAU

The plant height differed significantly ($P \leq 0.05$) due to integrated nutrient with foliar applications. The treatment T_{12} (50% RDF NPK ha^{-1} +Vermicompost @ 5t ha^{-1}+ Maize maxim +Panchgavya @ 3%) significantly recorded higher plant height of 104.7, 242.54 and 256.79 cm at 30, 60 DAS and at harvest, respectively. it might be due to organics and inorganics application to maize along with the presence of beneficial microorganisms, nutrients and growth regulators in panchagavya and maize maxim. The similar findings were reported by Vimalendran and Wahab[12] and Karan *et al.*,[11].

Highest leaf area index of 5.06 and 7.38 at 30 and 60 DAS, respectively were also noticed in the above said treatment. This might be due to the presence of significant quantity of vitamins, natural phytoregulators, macro and micro nutrients, in liquid organic manure in a balanced form might have helped to retard leaf senescence that resulted in large retention of effective photo assimilatory surface and in turn higher leaf area. The same treatment also recorded the highest DMP of 5356, 8117 and 10813 kg ha^{-1} at 30, 60 DAS ad at harvest respectively. This is due to better solar radiation interception and photosynthetic rate, contributing to higher values of varied growth attributes. Similar findings were also reported by Naik *et al.* (2013). Generally all growth parameters were higher in maize intercropped with legumes than in maize raised in pure stand. This may be attributed to the beneficial effects of legumes as asosiated crops (Pantra *et al*., (1999). Similar result was found by Banik *et al.*,[1].

The highest yield was obtained under treatment of T12 (50% RDF NPK ha^{-1} +Vermicompost @ 5t ha^{-1}+ Maize maxim +Panchgavya @ 3%). This might be due to adequate supply of nutrients at different growth stages of the crop as well as presence of growth regulators in Panchagavya contributing to higher cob yield[8,9].

The results of the present study showed that maize grown under irrigated condition in North western zones of Tamilnadu was highly responsive to this nutrient management practices. In general maize + cowpea intercropping system with the application of 50 percentage of RDF and 5 tones of vermicompost along with foliar spray of panchagavya @3% and TNAU maize maxim 7.5kg ha^{-1} at tassel initiation and grain filing stages recorded the highest growth and yield attributes of maize.

References :

1. Banik P, T Sasmal, PK Ghosal, and DK. Bagchi (2000) *Journal of Agronomy and Crop Science.; 185:* 9-14. 5.
2. Gupta, Satyendra Kumar, Chhatrapal Singh Puhup, and O. P. Rajwade (2018) *Trends in Biosciences 11*(3) : 391-392.
3. Li L, SC Yang, XL Li, FS Zang, and P. Christie (1999) *Plant Soil., 212:* 105-14.
4. Naveen K, GB Mallikarjuna, S Maadagavi MV Kumar, and ST. Bhairappanaver (2014) *Environment and Ecology., 32*(1): 63-66.
5. Ogutu, M. O., *et al*. (2012) "Effects of inter-specific interaction of nitrogen fertilizer and bean-maize cropping systems on quality of bean seed in Western Kenya." *Kenya Agricultural Research Institute. Kenya*.
6. Patra BC, BB Mandal, BK Mandal, and AK. Padhi (1999) *Indian Journal of Agricultural Sciences., 69*(11): 759-762.
7. Rajesh Ranjan Kumar, Neeraj Kumar, Jang Bahadur Ra-na and Kedar Nath Rai. (2018). *Int. J. Curr. Microbiol. App. Sci., 7*(9): 21-34.
8. Somasundaram, E., N. Sankaran, S. Meena, T. M. Thiyagarajan, K. Chandragiri, and S. Pannerselvam. (2003). *Madras Agric. J*., *90:* 169-172.
9. Sridhar, T. (2003). Effect of bio-regulators on Black night- shade (*Solanum* nigrum L.). M.Sc. Thesis. Tamil Nadu Agricultural University, Coimbatore, India.
10. Swaminathan MS. (1998) Crop production and sustainable food security. (in) Crop productivity and sustainability- shaping the future. Chopra VL, Singh RB, Verma A (Eds). Proceeding of the 2nd International Crop Science Congress, New Delhi, India. 3-18.
11. Verma Karan, A.D. Bindra, Janardan Singh, S.C. Negi, Naveen Datt, Usha Rana and Sandeep Manuja, (2018). *Int. Jr. Pure App. Bio sci*., *6*(3): 282-301.
12. Vimalendran, L and K. Wahab. (2014). *J. Appl. And Nat. Sci., 6*(2): 397-401.
13. Zhu Y, H Chen, J Fan, Y Wang, Y Li, J Chen, J Fan, S Yang, L Hu, H Lueng, TW Mew, PS Teng, and ZCC. Wang (2000) *Nature., 406:* 718-722.