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EFFECT OF ORGANICS ON MORPHO-PHYSIOLOGICAL TRAITS AND GRAIN YIELD OF MAIZE (*ZEA MAYS L.*)

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ABSTRACT

A field experiment was undertaken during *Kharif* Season 2011 in the Main Agricultural Research Station, University of Agricultural Sciences Dharwad with a view to study the effect of organics on morpho-physiological traits and grain yield of maize (*Zea mays* L.). Application of organic and inorganic sources of nutrient in combination remarkably increased leaf area, leaf area index, total dry matter and grain yield of maize in alone. Poultry manure @ 1.5 t ha^{-1} + 100% RDF recorded significantly higher leaf area, leaf area index, total dry matter and grain yield in comparison to other treatments and this was followed by Sheep manure @ 1.87 t ha^{-1} + 100% RDF. At 60 DAS, Poultry manure @ 1.5 t ha^{-1} + 100% RDF increased the leaf area (13.50 dm^{-2} $plant^{-1}$), leaf area index (4.45) , total dry matter at harvest (292.6 g $plant^{-1}$) and grain yield (90.2 q/ha) over control. The lowest leaf area, LAI, TDM and grain yield was recorded in control. From the study it can be concluded that combined application of poultry manure @ 1.5 t ha^{-1} + 100% RDF recorded higher growth parameters and yield of maize.

INTRODUCTION

Maize is the third most important cereal crop of world and India after wheat and Rice. Maize has been an important cereal crop owing to its highest production potential and adaptability to wide range of environment hence called as 'Queen of Cereals'. In world maize is cultivated in 146 Mha with production of 685 million tonnes and an average production of 4.7t/ha. In India, maize is cultivated in 8.67 mha with a production of 22.26 mt with an average productivity of 2566 kg/ha, contributing nearly 8% in the national food basket (DACNET, 2014). The global area under organic production accounts more than 31mh (Yadav, 2007). By 2020, the requirement of maize for various sectors will be around 100mt, of which poultry sector needs 31mt. Hence, is a challenging task to increase the maize production from present level (Sheshaiah, 2000). The future sustainability of the maize production will greatly depend on the balanced fertilization of organic and inorganic fertilizers for optimum plant growth and nutrient supply for realizing yield potential of crop. It is widely accepted that neither use of organic manures alone nor chemical fertilizers can achieve the sustainability of the yield under the modern intensive farming. Contrary to detrimental effects of inorganic fertilizers, organic manures are available indigenously which improve soil health resulting in enhanced crop yield. However, the use of organic manures alone might not meet the plant requirement due to presence of relatively low level of nutrients. Therefore, in order to make the soil well supplied with all the plant nutrients in the readily available form and to maintain good soil health, it is necessary to use organic manures in conjunction with inorganic fertilizers to obtain optimum yields (Ramalakshmi *et al.*, 2012)

Maize being an heavy consumer of 'N 'needs to be supplied with both inorganic and organic fertilizer to increase the crop productivity, grain yield, LAI and TDM. (Kudtarkar *et al.,* 2005). Hence the present study was undertaken to study the effect of organics on different morpho-physiological traits and grain yield of maize.

MATERIALS AND METHODS

Field experiment was conducted during *Kharif* season 2011 at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad located at 15º12'N latitude, 75º07' E longitudes and at an altitude of 678m above mean sea level. The soil of experimental site was medium black soils with neutral in pH (7.6) Potentiometry method (Piper, 1966), Medium organic carbon (0.75%) Wet oxidation method (Jackson, 1973), Available nitrogen (263.0 kg ha^{-1}) Modified Kjeldahl method (Jackson, 1973), Available Phosphorous (21.2 kg ha^{-1}) Olsen's method (Muhr *et al.*, 1965) and Available Potassium (429.0 kg ha^{-1}) Flame photometry (Jackson, 1973). The experiment was laid out in randomized block design, having 14 treatments *Viz*, T_1 FYM@ 7.5 t ha^{-1} + 100% RDF, T_2 - vermicompost @ 3.75 t ha^{-1} + 100% RDF, T_3 – poultrymanure @ 1.5 t ha^{-1} + 100% RDF, T_4 - sheepmanure @ 1.87 t ha^{-1} + 100% RDF, T_5 – FYM alone (RDN equivalent basis), T_6 - vermicompost alone (RDN equivalent basis), T_7 - poultrymanure alone (RDN equivalent basis), T_8 - sheepmanure

alone (RDN equivalent basis), T_9 -Farmyard manure @ 7.5 t ha^{-1} + 50% RDF, T_{10} - vermicompost @ 3.75 t ha^{-1} + 50% RDF, T_{11} - poultrymanure @ 1.5 t ha^{-1} + 50% RDF, T_{12} - sheepmanure @ 1.87 t ha^{-1} + 50% RDF, T_{13} - RDF alone and T_{14} - Control (No organics & No RDF) and replicated thrice. Recommended dose of fertilizer as per package of practice 100:50:25 kg ha^{-1} of N, P_2O_5 and K_2O respectively as per recommendation were applied through urea, DAP & Muriate of Potash as per treatments. Half dose of nitrogen and full dose of phosphorous and potassium was applied basally. Remaining half N dose was top dressed on 30th day after sowing.

Growth and yield parameters were recorded as per standard procedures. Leaf area (Saxena and Singh, 1965) and LAI (Sestak *et al.*, 1971.)Dry weight was recorded separately at each stage to assess dry matter accumulation in different parts and total dry matter production was expressed in gram per plant.

Grain yield (q/ha)

At physiological maturity cobs from each net plot were harvested. Cobs were separated, air dried, shelled, cleaned and weighed. Grain yield per ha was worked out and expressed in q per ha.

RESULTS AND DISCUSSION

Result revealed that application of organic and inorganic source in combination increased the morpho-physiological traits (Table 1). Application of Poultry manure @ 1.5 t ha^{-1} + 100% RDF significantly recorded higher morpho-physiological traits *Viz*, at 60 DAS leaf area was 13.50 (dm^{-2} $plant^{-1}$) and leaf area index 4.45 followed by the treatment Sheep manure @ 1.87 t ha^{-1} + 100% RDF than other combinations and significantly superior over control, RDF and organics. The minimum morpho-physiological traits *Viz.*, leaf area 8.20 (dm^{-2} $plant^{-1}$), and leaf area index 2.95 were recorded in control. Similar findings were also reported by Mohamoud *et al.* (2002) and Ashok Kumar *et al.* (2005).In the present study, leaf area increased upto 90 DAS and decreased thereafter due to senescence and ageing of leaves. The highest leaf area and

Table 1: Influence of organics on leaf area (dm^2 $plant^{-1}$) and leaf area index at different growth stages of maize

Treatments	Leaf area (dm^2plant^{-1})			Leaf area index		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1 : FYM @ 7.5 t ha^{-1} + 100% RDF	5.67	12.60	12.10	0.68	4.12	3.62
T_2 : Vermicompost @ 3.75 t ha^{-1} + 100% RDF	5.70	12.90	12.40	0.69	4.29	4.02
T_3 : Poultry manure @ 1.5 t ha^{-1} + 100% RDF	6.20	13.50	13.30	0.72	4.45	4.36
T_4 : Sheep manure @ 1.87 t ha^{-1} + 100% RDF	6.00	13.20	12.90	0.71	4.40	4.27
T_5 : FYM alone	4.00	9.10	7.80	0.40	3.09	2.53
T_6 : Vermicompost alone	4.12	9.40	8.30	0.43	3.23	2.78
T_7 : Poultry manure alone	4.50	9.90	8.90	0.47	3.48	3.06
T_8 : Sheep manure alone	4.21	9.70	8.70	0.43	3.43	2.99
T_9 : FYM + 50% RDF	4.92	10.30	9.30	0.50	3.63	3.24
T_{10} : Vermicompost + 50% RDF	5.22	10.80	9.80	0.55	3.73	3.34
T_{11} : Poultry manure + 50% RDF	5.50	11.90	11.05	0.57	3.83	3.47
T_{12} : Sheep manure + 50% RDF	5.44	11.50	10.60	0.56	3.78	3.39
T_{13} : RDF only	5.90	12.30	11.80	0.66	3.88	3.54
T_{14} : Control	3.96	8.20	6.90	0.36	2.95	2.34
S.Em+	0.25	0.37	0.30	0.03	0.13	0.10
CD (0.05)	0.71	1.07	0.86	0.09	0.37	0.29

DAS = Days after sowing; RDF – Recommended dose of fertilizer

Table 2: Influence of organics on total dry weight (g $plant^{-1}$) and grain yield (q ha^{-1}) at different growth stages of maize

Treatments	Total dry weight (g $plant^{-1}$)				Grain yield q/ ha
	30DAS	60DAS	90DAS	Atharvest	
T_1 : FYM @ 7.5 t ha^{-1} + 100% RDF	12.5	127.1	247.7	270.9	82.60
T_2 : Vermicompost @ 3.75 t ha^{-1} + 100% RDF	12.9	133.4	264.1	291.8	82.80
T_3 : Poultry manure @ 1.5 t ha^{-1} + 100% RDF	13.6	143.9	292.6	331.6	90.20
T_4 : Sheep manure @ 1.87 t ha^{-1} + 100% RDF	13.4	139.6	283.4	314.5	83.60
T_5 : FYM alone	8.0	73.2	132.3	140.3	14.30
T_6 : Vermicompost alone	8.3	76.1	136.0	140.4	17.10
T_7 : Poultry manure alone	8.9	84.3	160.2	165.5	25.57
T_8 : Sheep manure alone	8.6	80.4	152.2	157.6	22.30
T_9 : FYM + 50% RDF	9.6	90.7	173.2	185.1	34.73
T_{10} : Vermicompost + 50% RDF	10.1	95.9	180.5	194.5	39.43
T_{11} : Poultry manure + 50% RDF	10.4	101.4	204.2	217.5	56.97
T_{12} : Sheep manure + 50% RDF	10.1	98.5	195.6	207.3	44.63
T_{13} : RDF only	11.9	118.6	228.2	245.2	82.20
T_{14} : Control	7.5	64.4	112.9	114.0	9.60
S.Em+	0.49	3.32	5.77	13.43	10.31
CD (0.05)	1.44	9.64	16.78	39.05	29.42

DAS = Days after sowing RDF – Recommended dose of fertilizer

leaf dry weight could be attributed to higher dry matter accumulation in different plant parts (Abdulkadir *et al*. 2002). Poultry manure has a low and stable C:N ratio, when added to soil, poultry manure maintains low bulk density and high moisture holding capacity for a longer time as it is stable as compared to other organics under study, which are having relatively higher and less stable C:N ratio. Thus poultry manure helps in improving water holding capacity of soil which maintains water balance in leaf, hence keeps leaves fully fledged. (Madhavi *et al*.2009).Significantly higher leaf area index (4.45) was recorded under poultry manure @ 1.5t ha^{-1} + 100% RDF than control, RDF and organics alone. This was followed by the treatment Sheep manure @ 1.87t ha^{-1} + 100% RDF. Minimum LAI (2.95) was recorded under control. Govindappa (2003) reported that the high leaf area per plant was responsible for photosynthetic activity which in turn resulted in higher dry matter production.

Data in Table 2 show the amount total dry matter (TDM) produced is an indication of the overall efficiency of utilization of the resources and better light interception. The amount of TDM significantly increased due to the combined use of organic and inorganic sources of nutrient. At harvest higher TDM was obtained in the treatment receiving poultry manure @ 1.5t ha^{-1} + 100% RDF 331.6 (g $plant^{-1}$) than control, RDF and organics alone. This was followed by sheep manure @ 1.87 t ha^{-1} + 100% RDF 3.45 g $plant^{-1}$. Minimum TDM was recorded under control 114.0 (g $plant^{-1}$). Similar findings also given by Karki *et al* (2005). The highest grain yield (90.2q/ha) were recorded under poultry manure@ 1.5 t ha^{-1} + 100% RDF than control, RDF and organics alone. This was followed by the treatment sheep manure @ 1.87 t ha^{-1} + 100% RDF. Minimum grain yield (9.6 q/ha) was recorded under control. The results are also in conformity with findings of Shashidhar *et al*. (2009) and Balai *et al*. (2011) and Sudheendra *et al*. (2014). The higher yield associated with higher level of inorganic fertilizers in combination with organic manures may be due to its greater availability and uptake of macro and micro nutrients and active participation in carbon assimilation, photosynthesis, starch formation, translocation of protein and sugar, entry of water into plants, roots and development i.e., from somatic to reproductive phase leading to higher grain and straw yield. Mohanty *et al*. (2013). Improvement in yield due to combined application of inorganic fertilizer and organic manure might be attributed to control release of nutrients in the soil through mineralization of organic manure which might have facilitated better crop growth (Katkar *et al*., 2011). From the study it can be concluded that combined application of poultry manure @ 1.5 t ha^{-1} + 100% RDF recorded higher growth parameters and yield of maize.

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