*Forage Res.,* **47** (1) : pp. 130-134 (2021) **http://forageresearch.in**

# EFFECT OF DIFFERENT ORGANIC SOURCES OF NUTRIENTS ON GREEN FODDER YIELD, NUTRIENT UPTAKE AND ECONOMICS OF FODDER MAIZE AND SUCCEEDING FODDER COWPEA UNDER MAIZE-COWPEA CROPPING SYSTEM

**H. NAVEENA[1], B. G. SHEKARA[2]*, K. N. MANOJ[3] AND N. M. CHIKKARUGI[2]**

[1]Department of Agronomy, COA, V. C. Farm, Mandya, UAS, Bengaluru (Karnataka), India
[2]AICRP on Forage Crops, ZARS, V.C. Farm, Mandya (Karnataka), India
[3]Department of Agronomy, UAS, GKVK, Bengaluru (Karnataka), India
**(e-mail: bgshekar66@gmail.com)*

**(Received : 04 June 2021; Accepted : 25 June 2021)**

## SUMMARY

A field experiment was conducted during *kharif* and *rabi* seasons of 2019-20 at Zonal Agricultural Research Station, Vishweswaraiah Canal Farm, Mandya, Karnataka to study the effect of different organic sources of nutrients on production potential and profitability of fodder maize-cowpea cropping system. The experiment was laid out in a randomized complete block design with ten treatments comprising different organic sources of nutrients and replicated thrice. The data revealed that, application of 50% RDN through FYM and remaining 50% RDN through poultry manure as top dress at 30 DAS resulted higher green fodder yield (424.13 and 188.67 q/ha) and dry matter yield (117.13 and 40.18 q/ha) both in fodder maize and succeeding fodder cowpea, respectively. The same combination of organic nutrients sources also recorded higher nitrogen (217.03 and 111.25 kg/ha), phosphorus (21.17 and 6.82 kg/ha) and potassium uptake (208.14 and 69.79 kg/ha) at harvest and also found profitable with higher net returns (Rs. 53043/ha and Rs. 24104/ha) and benefit cost ratio (2.67 and 2.05) both in fodder maize and succeeding fodder cowpea, respectively.

**Key words :** Green fodder, poultry manure, fodder maize, fodder cowpea, nutrients uptake

The current agricultural systems in the country are largely prone to unsustainability in terms of food and fodder production due to excess use of chemicals, pesticides, fertilizers that plays a major role in deterioration of soil health, pollution of ground water resources and excess erosion which ultimately leads to leaching of mobile nutrients from soil and resulted in low soil productivity and decreased farm income. Even though, inorganic fertilizers plays a key role in meeting the nutrient requirement of crop for normal growth and development, the nutrient depletion and leaching is posing a drastic threat to sustainable and environment friendly agriculture. In this juncture, there is a need to decrease the usage of chemical fertilizers and in turn need to increase the use of different locally available farm waste for preparation of organic manures such as FYM, vermicompost, bio compost, poultry manure as source of nutrients which is cheaper and provides a way for sustainable agriculture production (Abubakar and Ali, 2018). On the other hand the livestock sector is the vital component of rural economy and acts as a backbone in improving the livelihood of farmers. The basis of animal wealth and health in any nation depends on availability of quality forages. In the recent years, livestock suffering from malnutrition is the burning issue in underdeveloped nations, which is mainly due to insufficiency of fodder and lack of pasture grazing lands that resulted in decreased production potentiality when compared to developed nations. To overcome these problems, dairy farmers resort to the greater usage of lavish concentrate feeds, which leads to enhanced cost of milk production and accounts for nearly 65 to 70 per cent of the total cost of milk production (Kumar *et al.,* 2012). Thus increasing the green fodder production in the country will helps to sustain the needs of increasing livestock population in the country.

Maize (*Zea mays*) is an important cereal crop and plays a significant role in food security after rice and wheat across the world. Maize is having a special significance due to its addition to staple food for human beings, also as a source of quality feed for livestock. Maize is used as a fodder crop since several decades, due to its higher green fodder yield, short duration, free from anti nutritional elements, highly succulent and vast suitable for silage making (Aqbal and Ahmad, 2015). Similarly among the legumes fodder crops, cowpea is one of the important fodder crop that can be grown throughout the year because of its short duration and is a ideal crop for crop rotation and inter or mixed cropping system. Besides having higher crude protein and lower crude fiber content, it fixes atmospheric nitrogen and improves soil heath. Both maize and cowpea also forms a major constituent in poultry feed across the country. In this context, the present experiment was conducted with different organic sources of nutrients to know the production potential and profitability of the fodder maize and cowpea under maize-cowpea cropping system.

## MATERIALS AND METHODS

The field experiment was conducted during *kharif* and *rabi* seasons of 2019-2020 at Zonal Agricultural Research Station, Vishweshwaraiah Canal Farm, Mandya, University of Agricultural Sciences, Bangalore, which is situated between 11º 30' and 13º 05' North latitude and 76º 05' and 77º 45' East longitude at an altitude of 695 m above mean sea level and falls under Southern Dry Zone (ZONE-VI) of Karnataka. The soil of experimental site is sandy loam in texture with neutral in reaction (7.1), medium in organic carbon content (0.65 %), available nitrogen (318.5 kg/ha), phosphorus (24.5 kg/ha) and potassium (247.8 kg/ha). The experiment was laid out in organically converted plot under Randomized Complete Block Design with ten treatments comprising of different organic sources of nutrients and replicated thrice. The organic manure was applied based on 'N' equivalent three weeks prior to sowing as basal and top dressed at 30 DAS as per treatments to meet the nitrogen requirement of maize crop and no organic manures was applied for succeeding crop of fodder cowpea and no inorganic fertilizer was applied to meet the demand of either N, P and K for both the crops. Fodder maize was harvested manually from net plot area when the crop attained milky stage while succeeding fodder cowpea at 50 per cent flowering. At the time of harvesting green fodder yield was recorded and known quantity of sample was taken and oven-dried at 70 ± 2°C temperature, powdered and analyzed for nitrogen and phosphorus content as per procedure given by Jackson (1973) while potassium as per the procedure adopted by Piper (1966). The economics of each treatment was worked out with prevailing market price of inputs and outputs and computed in terms of gross returns, net returns and benefit cost ratio. The data was statistically analyzed and results were interpreted.

## RESULTS AND DISCUSSION

### Biomass yield

The green fodder and dry matter yield of fodder maize was not significantly influenced by different source of organic nutrients (Table 1). However, numerically higher green fodder yield

TABLE 1

Effect of organic sources of nutrients on biomass yield of fodder maize and cowpea under fodder maize-cowpea cropping system

| Treatments | Green fodder yield (q/ha) | | Dry matter yield (q/ha) | |
|---|---|---|---|---|
| | Fodder Maize | Fodder Cowpea | Fodder Maize | Fodder Cowpea |
| $T_1$ : 100% RDN through FYM | 394.84 | 107.54 | 93.25 | 19.56 |
| $T_2$ : 75% RDN through FYM + 25% RDN through VC at 30 DAS | 395.10 | 112.08 | 95.33 | 20.61 |
| $T_3$ : 75% RDN through FYM + 25% RDN through BC at 30 DAS | 398.56 | 126.92 | 96.28 | 24.19 |
| $T_4$ : 75% RDN through FYM + 25% RDN through PM at 30 DAS | 406.40 | 130.25 | 100.38 | 25.34 |
| $T_5$ : 50% RDN through FYM + 50% RDN through VC at 30 DAS | 419.48 | 164.88 | 111.76 | 34.31 |
| $T_6$ : 50% RDN through FYM + 50% RDN through BC at 30 DAS | 420.22 | 175.42 | 113.85 | 35.84 |
| $T_7$ : 50% RDN through FYM + 50% RDN through PM at 30 DAS | 424.13 | 188.67 | 117.13 | 40.18 |
| $T_8$ : 50% RDN through FYM + 25% RDN each through VC & BC at 30 DAS | 408.22 | 135.63 | 102.58 | 27.32 |
| $T_9$ : 50% RDN through FYM + 25% RDN each through VC & PM at 30 DAS | 410.47 | 137.92 | 104.35 | 28.13 |
| $T_{10}$ : 50% RDN through FYM + 25% RDN each through BC & PM at 30 DAS | 411.07 | 159.93 | 107.66 | 32.99 |
| S. Em. ± | 19.08 | 9.89 | 7.11 | 2.54 |
| C. D. (p=0.05) | NS | 29.38 | NS | 7.56 |

Note: RDN=Recommended dose of nitrogen, FYM = Farm yard manure, VC = Vermicompost, BC = Bio-compost, PM = Poultry manure, DAS = Days after sowing.

(424.13 q/ha) and dry matter yield (117.13 q/ha) was observed with 50% RDN through FYM and remaining 50% RDN through poultry manure as top dressed at 30 DAS, while lower yield was recorded with 100% RDN through FYM (394.84 q/ha and 93.25 q/ha, respectively). The improved plant growth parameters like plant height, leaf to stem ratio and dry matter accumulation due to higher nutrient content and quick release of nitrogen from poultry manure might be the reason for higher green and dry matter yield. Similar kind of results was also reported by Thavaprakaash *et al.* (2005), Uwah *et al.* (2011) and Uwah *et al.* (2014).

On the other hand the residual effect of various sources of organic nutrients significantly influenced the total green fodder and dry mater yield of succeeding fodder cowpea (Table 1). Application of 50% RDN through FYM and remaining 50% RDN through poultry manure top dressed at 30 DAS resulted significantly higher green fodder (188.67 q/ha) and dry mater yield (40.18 q/ha) of fodder cowpea followed by application of 50% RDN through FYM + 50% RDN through bio-compost at 30 DAS (175.42 and 35.84 q/ha, respectively) and 50% RDN through FYM + 50% RDN through vermicompost at 30 DAS (164.88 and 34.31 q/ha, respectively). However, significantly lower green fodder and dry matter yields were recorded with 100% RDN applied through FYM (107.54 and 19.56 q/ha, respectively). The higher mineralization potential and constant release of nutrients by poultry manure might have caused positive influence on photosynthetic rate and partitioning of photosynthates in the plant and there by resulted in higher biomass yield of succeeding cowpea crop. These results are in conformity with the findings of Ismail (2007), Amanullah *et al.* (2006) and El-sheikh *et al.* (2004).

## Nutrient uptake

The different organic sources of nutrients had significant influence on nutrient uptake by both fodder maize and succeeding fodder cowpea under maize-cowpea cropping system (Table 2). In case of fodder maize at 30 days after sowing, significantly higher nitrogen, phosphorus and potassium uptake (58.77, 5.88 and 56.67 kg/ha, respectively) was observed with the application of 100% RDN through FYM and which was closely followed by 75% RDN through FYM + 25% RDN through bio-compost at 30 DAS (54.47, 5.41 and 55.30 kg/ha, respectively). However, significantly lower nitrogen and potassium uptake (39.57 and 36.63 kg/ha, respectively) was recorded with the application of 50% RDN through FYM + 50% RDN through vermicompost at 30 DAS while, lower phosphorus uptake (3.32 kg/ha) was noticed with application of 50% RDN through FYM + 50% RDN through bio-compost at 30 DAS. In contrast to this at harvest, application of 50% RDN through FYM + 50% RDN through poultry manure as top dress at

TABLE 2

Effect of organic sources of nutrients on nutrient uptake by fodder maize and fodder cowpea at different growth stages under fodder maize-cowpea cropping system

| Treatments | Nutrient uptake by fodder maize (kg/ha) | | | | | | Nutrient uptake by fodder cowpea (kg/ha) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | At 30 days | | | At harvest | | | At 30 days | | | At harvest | | |
| | N | P | K | N | P | K | N | P | K | N | P | K |
| $T_1$ | 58.77 | 5.88 | 56.67 | 123.82 | 11.84 | 120.28 | 16.92 | 1.48 | 14.82 | 52.75 | 2.93 | 24.21 |
| $T_2$ | 50.74 | 5.07 | 52.31 | 131.74 | 13.29 | 129.25 | 18.52 | 1.88 | 17.77 | 55.58 | 3.28 | 26.88 |
| $T_3$ | 54.47 | 5.41 | 55.30 | 139.16 | 13.44 | 138.20 | 17.96 | 1.76 | 17.46 | 69.78 | 3.64 | 33.74 |
| $T_4$ | 52.87 | 4.81 | 52.07 | 147.73 | 15.21 | 144.52 | 18.51 | 1.76 | 18.11 | 67.64 | 3.79 | 35.42 |
| $T_5$ | 39.57 | 3.60 | 36.63 | 192.75 | 19.74 | 187.40 | 26.54 | 2.00 | 17.67 | 94.71 | 6.19 | 55.74 |
| $T_6$ | 41.13 | 3.32 | 40.13 | 207.85 | 20.28 | 200.56 | 32.51 | 1.95 | 20.97 | 98.48 | 6.36 | 61.43 |
| $T_7$ | 40.50 | 3.48 | 41.77 | 217.03 | 21.17 | 208.14 | 34.53 | 2.13 | 21.76 | 111.25 | 6.82 | 69.79 |
| $T_8$ | 41.88 | 4.05 | 38.84 | 170.64 | 17.02 | 163.05 | 19.48 | 1.26 | 17.47 | 76.09 | 4.54 | 42.36 |
| $T_9$ | 40.48 | 3.71 | 41.15 | 176.63 | 17.50 | 170.80 | 19.20 | 1.36 | 12.68 | 78.54 | 5.10 | 45.32 |
| $T_{10}$ | 41.46 | 3.34 | 44.47 | 187.17 | 18.35 | 179.23 | 25.03 | 1.63 | 18.95 | 91.04 | 5.66 | 53.92 |
| S.Em. ± | 2.65 | 0.24 | 2.67 | 12.07 | 1.56 | 11.68 | 1.39 | 0.10 | 1.03 | 6.88 | 0.47 | 4.29 |
| C. D. (p=0.05) | 7.87 | 0.72 | 7.94 | 35.86 | 4.62 | 34.70 | 4.13 | 0.30 | 3.06 | 20.45 | 1.38 | 12.75 |

30 DAS recorded significantly higher nutrient uptake (217.03, 21.17 and 208.14 kg/ha, respectively) followed by 50% RDN through FYM + 50% RDN through bio-compost as top dress at 30 DAS (207.85, 20.28 and 200.56 kg/ha, respectively) while lower nutrient uptake noticed with the application of 100% RDN through FYM (123.82, 11.84 and 120.28 kg/ha, respectively).

In case of succeeding fodder cowpea crop at 30 days after sowing, significantly higher nitrogen, phosphorus and potassium uptake (34.53, 2.13 and 21.76 kg/ha, respectively) was observed with the application of 50% RDN through FYM + 50% RDN through poultry manure as top dress at 30 DAS which was closely followed by 50% RDN through FYM + 50% RDN through bio-compost as top dress at 30 DAS (32.51, 1.95 and 20.97 kg/ha, respectively). However, significantly lower nitrogen (16.92 kg/ha), phosphorus (1.26 kg/ha) and potassium uptake (12.68 kg/ha) was noticed with application of 100% RDN through FYM, 50% RDN through FYM + 25% RDN each through vermicompost and bio-compost as top dress at 30 DAS and 50% RDN through FYM + 25% RDN each through vermicompost and poultry manure as top dress at 30 DAS, respectively (Table 2). Similarly at harvest, significantly higher nutrient uptake (111.25, 6.82 and 69.79 kg/ha, respectively) was observed with the application of 50% RDN through FYM + 50% RDN through poultry manure as top dress at 30 DAS which was closely followed by 50% RDN through FYM + 50% RDN through bio-compost as top dress at 30 DAS (98.48, 6.36 and 61.43 kg/ha, respectively) while, lower nutrient uptake was recorded with the application of 100% RDN through FYM (52.75, 2.93 and 24.21 kg/ha, respectively). The faster rate of mineralization of nitrogen present in organic manure might be the reason for higher nitrogen content and thereby higher nitrogen uptake by the plant. Similarly formation of carbon dioxide during decomposition of organic manures might have resulted solubilization of native phosphorus and improvement in exchangeable potassium, that subsequently resulted more uptake by the crop (Singh *et al.,* 1981). Similar kind of results was also noticed by Karforma *et al.* (2016), Bama *et al.,* (2013) and Patel *et al.* (2018).

## ECONOMICS

In fodder maize, the higher gross returns (Rs. 84826/ha), net returns (Rs. 53043/ha) and benefit cost ratio (2.67) was obtained with application of 50 percent RDN through FYM and remaining 50% RDN through poultry manure as top dress at 30 DAS followed by 50% RDN through FYM and remaining 50% RDN through bio-compost as top dress at 30 DAS (Rs. 84044/ha, Rs. 52137/ha and 2.63, respectively). While, lower was recorded with 100% RDN through FYM (Rs. 78968/ha, Rs. 40218/ha and 2.04, respectively) (Table 3). Similarly in succeeding fodder cowpea, the higher gross returns (Rs. 47168/ha), net returns (Rs. 24104/ha) and benefit cost ratio (2.05) were noticed with application of 50% RDN through FYM and remaining 50% RDN through poultry manure as top dress at 30 DAS followed by 50% RDN through FYM and remaining 50% recommended N through bio-compost as top dress at 30 DAS (Rs. 43855/ha, Rs. 20792/ha and 1.90 respectively). While, lower with 100% RDN through FYM (Rs. 26885/ha, Rs. 3822/

TABLE 3

Economics fodder maize and cowpea under fodder maize-owpea cropping system as influenced by different sources of organic nutrients

| Treatments | Fodder Maize | | | Fodder Cowpea | | |
|---|---|---|---|---|---|---|
| | Gross returns (Rs./ha) | Net returns (Rs./ha) | B : C | Gross returns (Rs./ha) | Net returns (Rs./ha) | B : C |
| $T_1$ | 78968 | 40218 | 2.04 | 26885 | 3822 | 1.17 |
| $T_2$ | 79020 | 42967 | 2.19 | 28020 | 4957 | 1.21 |
| $T_3$ | 79712 | 42383 | 2.14 | 31730 | 8667 | 1.38 |
| $T_4$ | 81280 | 46013 | 2.30 | 32563 | 9500 | 1.41 |
| $T_5$ | 83896 | 50541 | 2.52 | 41220 | 18157 | 1.79 |
| $T_6$ | 84044 | 52137 | 2.63 | 43855 | 20792 | 1.90 |
| $T_7$ | 84826 | 53043 | 2.67 | 47168 | 24105 | 2.05 |
| $T_8$ | 81644 | 49013 | 2.50 | 33908 | 10845 | 1.47 |
| $T_9$ | 82094 | 49525 | 2.52 | 34480 | 11417 | 1.50 |
| $T_{10}$ | 82214 | 50369 | 2.58 | 39983 | 16920 | 1.73 |

ha and 1.17, respectively). The lower cost of poultry manure and bio-compost with higher nitrogen content resulted lower requirement along with higher biomass yield might be the reason for higher net returns and benefit cost ratio. These results are in accordance with the findings of Kumar and Singh (2017) and Bama *et al.* (2013).

Based on the results it can be inferred that application of 50% RDN through FYM and remaining 50% RDN through poultry manure top dressed at 30 DAS significantly improved the biomass yield and nutrient uptake in both fodder maize and fodder cowpea. The same combination of organic nutrient source also proved as profitable which recorded higher net monetary returns and B : C ratio compared to other combinations.

## REFERENCES

Abubakar, Z. A. and A. D. Ali, 2018 : Screening effect of organic manure on the vegetative growth of maize (*Zea mays* L.) *J. Biosci. Agric. Res.*, **16**(2) : 1356-1364.

Amanullah, M. M., A. Alagesan, K. Vaiyapuri, S. Pazhanivelan and K. Sathyamoorthi, 2006 : Intercropping and organic manures on growth and yield of cassava (*Manihot esculenta* Crantz). *Res. J. Agric. Biol. Sci.*, **2**(5) : 183-189.

Aqbal, M. A. and M. M. Ahmad, 2015 : Boosting spring planted irrigated maize (*Zea mays* L.) grain yield with planting patterns adjustment. *American-Eurasian J. Agric. Environ. Sci.,* **15** : 315-319.

Bama, K. S., K. Velayudham, C. Babu, K. Iyangar and A. Kalamani, 2013 : Enshot of different nutrient sources on fodder yield, quality and soil fertility status of multicut fodder sorghum grown soil. *Forage Res.,* **38**(4) : 207-212.

El-Sheik, E. A. and A. A. Elzidany, 2004 : Effect of *Rhizobium* inoculation, organic and chemical fertilizer on yield and physical properties on faba bean seeds. *J. Plant Food Human Nutri.,* **51**(2) : 137-144.

Ismail, F. M., 2007 : Effect of different rate of chicken manure on the growth and yield of forage sorghum (*Sorghum bicolor* L.). *M.Sc. Thesis* (Unpub.) Univ. of Khartoum, Sudan.

Jackson, M. K., 1973 : Soil chemical analysis. Prentice-Hall. Inc. Engle Wood Cliffs, New Jersey.

Karforma, J., M. Ghosh, D. C. Ghosh, S. Mandal and P. K. Ghosh, 2016 : Effect of integrated nutrient management on performance of rainfed fodder maize-rapeseed cropping system. *Range Mgmt. Agroforestry,* **37**(2) : 214-221.

Kumar, S., R. K. Agrawal, A. K. Dixit, J. B. Singh and S. K. Rai, 2012 : Forage production technology for arable lands. *Indian Grassland and Fodder Research Institute, Jhansi.* pp. 4-5.

Kumar, V. and A. P. Singh, 2017 : Long-term effect of green manuring and farm yard manure on yield and soil fertility status in rice-wheat cropping system. *J. Indian Soc. Soil Sci.*, **58** : 409-412.

Patel, K. M., D. M. Patel, D. G. Gelot and I. M. Patel, 2018 : Effect of integrated nutrient management on green forage yield, quality and nutrient uptake of fodder cowpea. *Int. J. Chem. Stud.,* **6**(1) : 173-176.

Piper, C. S., 1966 : *Soil and Plant Analysis*. *Inter Sci. Pub., Inc*., New York.

Singh, S. P., R. S. Chahal, and M. Singh, 1981 : Fertilizer management through organic and inorganic fertilizer in bajra-wheat crop sequence. *Ferti. News*. **26** : 16-19.

Thavaprakaash, N., K. Velayudham and V. B. Muthukumar, 2005 : Effect of crop geometry, intercropping systems and integrated nutrient management practices on productivity of babycorn (*Zea mays* L.) based intercropping systems. *Res. J. Agric. Biol. Sci.,* **1**(4): 295-302.

Uwah, D. F., A. E. Eneji and U. J. Eshiet, 2011 : Organic and mineral fertilizers effects on the performance of sweet maize (*Zea mays* L.) in eastern rainforest zone of Nigeria. *Int. J. Agric. Sci.,* **3**(1) : 54-61.

Uwah, D. F., U. L. Undie and N. M. John, 2014 : Comparative evaluation of animal manures on soil properties, growth and yield of sweet maize (*Zea mays* L.). *J. Agric. Environ. Sci.,* **3**(2) : 315-331.