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Nitrogen uptake, quality parameters and post harvest soil status of transplanted finger millet by organic, inorganic and biofertilizers

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Abstract

A field experiment conducted during rabi, 2013-14 on sandy loam soils of Agricultural college farm, Bapatla in transplanted white finger millet to observe the nitrogen use efficiency by organic, inorganic and biofertilizers. The experiment was laid out in Randomized Block Design with nine treatments replicated thrice. The results showed that the highest grain N-uptake were observed 75 % RDN + 25% N through Vermicompost (T_4) and highest straw uptake was recorded with 125% RDN + ST with Azospirillum @ 5kg ha^{-1} + 0.2% Zn spray at flowering stage. The overall N-uptake was high with 125% RDN + ST with Azospirillum @ 5kg ha^{-1} + 0.2% Zn spray at flowering stage.
Key words:- Finger millet,Vermicompost, FYM, Azospirillum, Zn-spray

I. INTRODUCTION

Finger millet(*Eleusine coracana* L. *Gaertn*) is an important small millet crop grown in India and has the pride place of having highest productivity among millets. Finger millet plays a vital role of providing quality nutrition to human race. The protein of finger millet is considered to be "biologically complete". Finger millet is normally grown on poor, marginal soils and imbalanced nutrient managements. Among various nutrients nitrogen is an inevitable nutrient for any crop. Combined application of nitrogen through organic manures and chemical fertilizers generally produces higher crop yield than sole application. Among various organic manures FYM, vermicompost, bio-fertilizers not only increase the yield but also improve the quality of taste of the produce. A complementary use of organic manures and chemical fertilizers may probably increase the efficiency of both these inputs and produce quality grain with much environmental safety. Besides this, soil application of biofertilizers was found to increase the crop yield through N-fixation thereby reducing the crop demand for the nitrogen, In view of the above, development of management methods for nitrogen for quantitative and qualitative production is required.

II. MATERIAL AND METHODS

A field trial was conducted during *rabi,* 2013-14. The experiment was laid out in a randomized block design with nine treatments viz., Control (T_1), 75% RDN + 25% N through FYM (T_2), 50% RDN + 50% N through FYM (T_3), 75% RDN + 25% N through Vermicompost(T_4),50% RDN + 50% N through Vermicompost (T_5),100% RDN (T_6),75% RDN + ST with *Azospirillum* @ 5Kg/ha+0.2% Zn spray at flowering (T_7),100% RDN + ST with *Azospirillum* @ 5Kg/ha +0.2% Zn spray at flowering (T_8) and 125% RDN+ ST with *Azospirillum* @ 5Kg/ha +0.2% Zn spray at flowering (T_9). The cultivar is Hima (VRW-936). The experimental soil was sandy loam in texture, slightly alkaline in reaction, low in organic carbon and available nitrogen, low in available phosphorus, low in available potassium. The test variety 'Hima (VRW-936) was sown at a spacing of 30cm × 10cm. Half of the recommended dose of nitrogen was applied through urea, as basal in all the treatments except T_3 and T_5 where farm yard manure and vermicompost are applied to meet 50% nitrogen requirement. All phosphorus, potassium was applied as basal and the remaining nitrogen was applied at 30 days after transplanting.

III. RESULTS AND DISCUSSION

A.Nitrogen uptake in grain

Higher grain N-uptake (74.3kg ha^{-1}) was recorded with 75% RDN + 25% N through Vermicompost (T_4) which was comparable with 125% RDN + ST with *Azospirillum* @ 5 kg ha^{-1} + 0.2% Zn spray at flowering stage (T_9) and significantly superior than other treatments. Among all treatments lowest grain N-uptake was recorded with control (T_1) compared to all other treatments.

B.Nitrogen uptake in straw

Straw N- uptake was higher (107.3kg ha^{-1}) with 125% RDN+ ST with *Azospirillum* @ 5 kg ha^{-1} + 0.2% Zn spray at flowering stage (T_9) which was on a par with 75% RDN + 25% N through Vermicompost (T_4) and significantly superior to all other treatments. Among all treatments, significantly the lowest N-uptake was recorded with control (T_1) compared to all other treatments. Similar result was observed with total N-uptake by crop without any deviations.

High N-uptake in grain with T_4 might be due to sufficient amount of N-content was supplied at reproductive stage and high straw N-uptake with T_9 might be due to high nitrogen supplied to the crop and highest drymatter obtained with this treatment.

C. Quality parameters

Protein content of grain was influenced by different nitrogen management treatments. High protein content of grain was recorded with 50% RDN +50% N through Vermicompost (T_5) and Zn-content of the grain was 75% RDN+ ST with *Azospirillum* @ 5 kg ha^{-1} + 0.2% Zn spray at flowering stage (T_7), 100% RDN+ ST with *Azospirillum* @ 5kg ha^{-1} + 0.2% Zn spray at flowering stage (T_8), 125% RDN+ ST with *Azospirillum* @ 5kg ha^{-1} + 0.2% Zn spray at flowering stage (T_9) than all the other treatments.

High protein content recorded with 50% RDN + 50% N through vermicompost(T_5) which might be to high amount of vermicompost in this treatment. High Zn-content with T_9**,** T_8 and T_7 might be due spraying of zinc at the time of flowering stage. The above data emphasizes the point that for improvement of Zn content in grain, spraying of 0.2% zinc is necessary at time of flowering. Similar observation was recorded by Arulmozhiselvan *et al.* (2013).

D. Post harvest soil npk status

Nitrogen

Among different treatments, application of 50 % RDN + 50% N through FYM (T_3) recorded high available nitrogen of the soil. This was comparable with 75% RDN + 25% N through FYM (T_2) which in turn was on a par with 50% RDN + 50 % N through Vermicompost (T_5). Among all treatments lowest phosphorus content was recorded with control (T_1) which was inferior to all other treatments.

Soil N content with integrated treatments of $T_{3,}$ $T_{2,}$ T_5 and T_4 significantly increased residual nitrogen content over the application of inorganic fertilizers alone. When FYM was added to the soil complex, nitrogenous compounds break down slowly and make steady N supply throughout the growth period of the crop, particularly in the form of inorganic N due to high C: N ratio compared to other organics. This was resulted in less utilization of N from FYM leading to build up of N in soils. This FYM might have helped to improve the soil physical, chemical and biological properties leading to overall improvement in soil health in the long run as expressed by Swarup (1987). The uptake of nitrogen from FYM was slow than Vermicompost, this might be cause for low residual nitrogen content in Vermicompost treatments than FYM treatments. Similar results were also reported by Arulmozhiselvan *et al.* (2013) and Parasuraman *et al.* (2000).

Low content of soil nitrogen in inorganic fertilized treatments might be due to higher uptake of nutrients as well as considerable losses of inorganic nitrogen from soils by leaching. Similar results were obtained with Anil Kumar *et al*., 2003. Lowest N content was recorded in control (T_1) treatment this might be due to no supply of nitrogen externally. The soil nitrogen which was present initially was used by the crop and hence recorded lowest nitrogen content than all treatments in control (T_1).

Phosphorus

Among different treatments, application of 50 % RDN + 50% N through FYM (T_3) recorded highest available Phosphorus content in the soil and was comparable with 75% RDN + 25% N through FYM (T_2),50% RDN + 50 % N through Vermicompost (T_5), 75% RDN +25% N through Vermicompost (T_4) and 125% RDN+ ST with *Azospirillum* @ 5kg ha^{-1}+0.2% Zn spray at flowering stage (T_9) and superior than all other treatments viz.,T_8, T_6, T_7 and T_1. Among all treatments lowest phosphorus content was recorded with control (T_1) which was inferior to all other treatments.

High availability of soil phosphorus with T_3 might be due to coating of sesquioxides by organic materials which might have reduced the phosphorus fixing by soil and released carbon dioxide and organic acids solubilising the native soil phosphorus. . Similar results were also reported by Varalakshmi *et al*. 2005 with FYM.

Potassium

Among different treatments, application of 50 % RDN + 50% N through FYM (T_3) recorded highest available potassium content in the soil. Among all treatments are control (T_1) recorded lowest amount of potassium content.

The beneficial effect of FYM on available potassium might be due to the reduction of potassium fixation, solubilisation and release due to the interaction of organic matter with clay besides the direct potassium addition to the potassium pool of soil. Similar results are observed by Tandon, 1991.

IV.Conclusion:-

From the above data it can be concluded that total nitrogen uptake by crop was highest with 125% RDN + ST with *Azospirillum* @ 5 kg ha^{-1}+ 0.2% Zn spray at flowering stage (T_9) which was on a par with 75% RDN + 25% N through Vermicompost (T_4) and found significantly superior than other treatments. With respect to quality of grain, high protein content of grain was recorded with vermicompost treatments (T_5 and T_4) .The Zn-content of grain was higher with 125% RDN, 100% RDN and 75% RDN in combination with ST with *Azospirillum* @ 5kg ha^{-1} + 0.2% Zn spray at flowering stage (T_9, T_8 and T_7) and remaining all were on par with each other. Post harvest available N, P and K status in the soil was recorded higher with organic manure treatments (T_3, T_2, T_4 and T_5).

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Table 1: Uptake of N by crop in transplanted finger millet as influenced by nitrogen management methods

Treatment	Nitrogen				
	Grain		Straw		Total crop Uptake
	Content (%)	Uptake (kg ha^{-1})	Content (%)	Uptake (kg ha^{-1})	
T_1 : Control	1.6	21.0	0.5	25.6	46.6
T_2 : 75% RDN + 25% N through FYM	1.8	62.2	1.1	89.2	151.4
T_3 : 50% RDN + 50%N through FYM	1.7	55.0	1.1	79.5	134.4
T_4 : 75% RDN + 25% N through Vermicompost	2.0	74.3	1.1	102.6	177.0
T_5 : 50% RDN + 50% N through Vermicompost	1.7	55.0	1.1	80.0	134.7
100% Recommended dose of nitrogen (RDN)	1.8	66.7	1.1	94.8	161.3
75%RDN + ST with *Azospirillum* @ 5 kg ha^{-1} +0.2% Zn spray flowering stage	1.8	60.9	1.1	87.0	148.0
: 100%RDN + ST with *Azospirillum* @5 kg ha^{-1} +0.2% Zn spray flowering stage	1.8	66.9	1.1	94.9	161.8
: 125% RDN+ ST with *Azospirillum* @ 5kg ha^{-1} +0.2% Zn spray flowering stage	1.9	73.2	1.2	107.3	180.5
S.Em±		2.1		2.75	5.3
CD (P=0.05)		6.2		8.3	16.0
CV (%)		6.0		5.6	6.4

Table 2: Protein and Zinc content in transplanted finger millet as influenced by nitrogen management methods

Treatment	Grain protein content (%)	Grain Zinc content (mg kg^{-1})
T_1 : Control	9.32	15.7
T_2 : 75% RDN+25% N through FYM	9.72	16.3
T_3 : 50% RDN+50%N through FYM	9.52	17.5
T_4 : 75% RDN+25% N through Vermicompost	10.71	18.5
T_5 : 50% RDN+50% N through Vermicompost	10.91	17.7
T_6 : 100% Recommended dose of nitrogen (RDN)	9.92	19.3
: 75%RDN+ ST with *Azospirillum* @ 5kg ha^{-1} + 0.2% Zn spray flowering stage	9.72	24.7
100%RDN+ ST with *Azospirillum* @ 5kg ha^{-1} + 0.2% Zn spray flowering stage	10.12	25.1
: 125% RDN+ ST with *Azospirillum* @ 5kg ha^{-1} + 0.2% Zn spray flowering stage	10.31	27.7
S.Em±	0.41	1.03
CD (P=0.05)	1.2	3.10
CV (%)	6.7	8.3

Table: 3 Post harvest available soil NPK status in transplanted finger millet as influenced by nitrogen management methods

Treatment	Soil N content	Soil P content	Soil K content
T_1 : Control	56.4	25.3	130.2
T_2 : 75% RDN+25% N through FYM	119.8	46.7	308.2
T_3 : 50% RDN+50%N through FYM	130.6	48.5	341.9
75% RDN+25% N through Vermicompost	103.5	43.7	287.5
50% RDN+50% N through Vermicompost	110.9	45.1	294.7
100% Recommended dose of nitrogen (RDN)	81.4	39.6	274.3
75%RDN+ ST with *Azospirillum* @ 5kg ha^{-1} + 0.2% Zn spray flowering stage	73.2	38.9	231.8
100%RDN+ ST with *Azospirillum* @ 5kg ha^{-1} + 0.2% Zn spray flowering stage	100.4	39.9	260.9
: 125% RDN+ ST with *Azospirillum* @ 5kg ha^{-1} + 0.2% Zn spray flowering stage	101.8	42.4	281.5
S.Em±	3.6	2.6	11.4
CD (P=0.05)	10.8	7.8	34.1
CV (%)	6.4	11.0	7.3

