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Influence of nitrogen, *Azospirillum* sp and farm yard manure on the yield, rhizome rot and quality of ginger (*Zingiber officinale* Rosc.)

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Abstract

The influence of Nitrogen fertilizer, *Azosprillium* sp. farm yard manure and their combinations on ginger (*Zingiber officinale* Rosc) was studied at Pottangi (Orissa). The highest fresh rhizome yield (18.70 q/ha), lowest rhizome rot (11%) and quality ginger (5.82% oleoresin content) with B: C ratio of 2:4 could be obtained in recommended dose of fertilizers 100% combined with *Azospirillum* sp. 10Kg/ha and FYM 10t/ha. *Azospirillum* has a prominent role in increasing productivity and quality of ginger while reducing the most challenging disease i.e the Rhizome rot of ginger. In some situations, inorganic N level can be reduced to 30% level in presence of bio-fertilizers to obtain economic return. In all organic farming situations, addition or *Azospirillum* to package of practices will enhance the production of ginger.

Key words: ginger, *Zingiber officinale*, *Azospirillum* sp. Nitrogen, farm yard manure, yield

Ginger (*Zingiber officinale* Rosc) as the highly remunerative spices is extensively cultivated in Koraput District of Orissa, from where seed materials are usually supplied to other districts of the state as well as to neighboring states like Andhra Pradesh, Chhatisgarh and Madhyapradesh. Following recommended package of practices, the crop can produce on an average 16.6 t/ha (OUAT, 2007). But the average farmer gets only 6.7 t/ha mostly due to high cost of inputs (Mohapatra & Acharya , 2006) and ignorance of modern technology. As, dominated by tribes, farmers are traditionally bent upon organic farming and hesitate to apply recommended doze of inorganic fertilizers (125:100:100Kg N, P_2O_5, K_2O/ha). Mishra & Gopalkrishnan (2006) stressed on organic production of ginger and turmeric keeping in view the increasing global demand for organic products .In fact the Govt. of Orissa has signed MOU with the APEDA (Authority for setting up Agril Export zone for Ginger in Koraput district of Orissa. Biofertilizers are less expensive, environment friendly, sustainable and can supplement the inorganic Nitrogen requirement of the crop to a considerable extent. Hence, the present investigation was carried out to assess the influence of *Azospirillum* sp, inorganic nitrogen fertilizer and FYM in different combinations on the yield, rhizome rot and quality of ginger.

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The experiment was conducted for five consecutive years from 2000-01 to 2004-05 at the High Altitude Research Station, Pottangi (Orissa) in the ginger variety Suprabha. Eight no of treatments viz. T1: FYM 10 t/ha, T2: FYM 20 t/ha, T3: *Azospirillum* 10 kg/ha + FYM 10 t/ha, T4: *Azospirillum* 10 kg/ha + FYM 20 t/ha, T5: 30% inorganic N+ *Azospirillum* 10 Kg/ha + FYM 10 t/ha, T6: 75% inorganic N+ Azospirillum 10 Kg/ha + FYM 10t/ha , T7, 100% inorganic N+ Azospirillum 10 Kg/ha + FYM 10t/ha andT8: !25 Kg N(recommended doze). Phosphorous 100 kg/ha, potash 100 kg/ ha were applied uniformly to each treatment. All the treatments were replicated thrice in a randomized block design. The rhizomes were sown during first week of May in 3 m x 1m size raised beds with a spacing of 25 cm x 20 cm. The entire dose of P & 50% K were applied in beds along with full FYM & *Azospirillum* as basal with 50%N at 45 DAS & balance 50% N & 50% K at 90 DAS. Mulching with paddy straw 20 t/ha were applied uniformly to all treatments. Observation on Rhizome rot were recorded at 90 Days After Sowing & yield at harvest during Ist week of January of subsequent a year. Essential oil and oleoresin content were analyzed after harvest. Economics of production for each treatment were calculated based on the prevailing market price & benefit: cost ratio were worked out for better interpretation of analyzed data.

Pooled analysis of data for five years indicated that the highest yield of fresh rhizome (18.70 t/ha) was obtained for treatment in which 100% recommended doze of inorganic fertilizer in combination with Azospirillum sps 10 Kg/ha & FYM 10 t/ha were applied to the soil (Table-1). The rhizome rot disease incidence was the lowest (11%) and Oleoresin content in rhizomes were the highest (5.82 %) in these treatments. The highest performance in this treatment might be resulting from integrated/combined effect of organic & inorganic nutrient availability to the plants.

Table 1. Effect of *Azospirillum* and nutrient on yield, disease incidence and quality of ginger (Var. Suprabha) at Pottangi, Orissa (2000-01 to 2004-05). Pooled data of 5 years

Tr.Sl	Treatment details/ha	Fresh Rhizome Yield Kg/3m^2	Fresh Rhizome Yield t/ha	Rhizome Rot (%)	E.oil (%)	Oleo-resin (%)	Cost Lakh (Rs)	B:C
1.	FYM10 t	4.15	9.54	21.00	1.00	4.60	1.50	1.27
2.	FYM 20 t	4.55	10.47	17.00	1.20	4.80	1.52	1.37
3.	*Azospirillum* 10 Kg+ FYM 10 t	4.45	10.23	16.00	1.00	5.00	1.51	1.36
4.	*Azospirillum* 10 Kg+ FYM 20 t	4.80	11.04	14.00	1.20	5.20	1.53	1.44
5.	N 30%+ *Azospirillum* 10 Kg + FYM 10 t	5.94	13.65	12.00	1.20	5.30	1.52	1.80
6.	N 75 %+ *Azospirillum* 10 Kg + FYM 10 t	6.58	15.12	13.00	1.00	5.40	1.53	1.97
7.	N 100 %+ *Azospirillum* 10 Kg + FYM 10 t	8.13	18.70	11.00	1.25	5.82	1.53	2.44
8.	N 100 % (125 Kg)	7.52	17.30	18.00	1.30	5.20	1.50	3.46
	Se(m)+-CD(0.05)	0.46	1.35	1.05	3.09	CD γ	CD γ	CD γ

Cost of Inputs: *Azospirillum* Rs. 100/Kg FYM Rs. 200/- /t, Urea Rs. 6.66/Kg
Cost of produce: Fresh ginger rhizome Rs. 20,000/-/t

Increased doze of FYM has increased the rhizome yield, essential oil content and oleoresin content in rhizomes besides decreasing rhizome rot incidence from 21 to 17 %. FYM combined with *Azospirillum* (T4) further, reduced the rhizome rot incidence to 14% level & there was increase in rhizome yield, essential oil and oleoresin content in rhizome. There was no significant difference in yield and quality of ginger when inorganic N level was reduced from 75% to 30% in presence of *Azospirillum* & FYM. Even if the highest performance was observed in maximum treatment (T7), results indicated that 30-40% inorganic N can be saved when applied in combination with *Azospirillum* & FYM. *Azospirillum* and FYM in enhancing yield of ginger (OUAT 2006, OUAT 2007), coriander (Malhotra *et al*, 2006) and black pepper (Kandiannan *et al*, 2000) were reported earlier.

Rhizome rot, the most challenging disease of ginger remained low in *Azospirillum* treated plots irrespective of other treatment variations. The disease incidence was higher (17-21%) in absence of *Azospirillum* as observed in T1, T2 and T8. Even with highest level of inorganic N, presence of *Azospirillum* kept the disease incidence to minimum of 11%. Besides Nitrogen fixing ability, the impact of biofertilizer suppressing fungal pathogens corroborate findings of Sharma et al. 1986 & Malhotra *et al.* 2006).

Oleoresin content which increases the quality of ginger was higher in all the treatments where *Azospirillum* were applied with exception of T8. Even, then, the highest oleoresin content in ginger was observed in T7 over T8 which shows that biofertilizers have a positive bearing in enhancing the oleoresin content and in other words the quality of ginger.

Economic of *Azospirillum* application indicated that the highest benefit: cost ratio could be obtained with 100% inorganic fertilizers (3.46) followed by 100% inorganic N+ *Azospirillum* + FYM, 75% inorganic N+ *Azospirillum*, +FYM and 30% inorganic N+ *Azospirillum* + FYM (2.44, 1.97 & 1.80, respectively)

Considering all the above aspects together three types of recommendations can be given for three situations. In one situation where the farmers are resource full, 100% recommended dose of inorganic fertilizers combined with *Azospirillum* 10 Kg/ha & FYM 10 t/ha can be recommended to obtain the highest ginger yield with highest quality and least rhizome rot incidence. In second situation, the resource poor farmers can reduce N level to 75% of requirement or maximum up to 30% level keeping other components constant for obtaining sizable income. Where 100% organic farming is practiced, farmers need to use *Azospirillum* 10 Kg/ha and FYM 20 t/ha to obtain sustainable income (B: C ratio of 1.44).

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