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EFFECT OF INTEGRATED NUTRITIONAL SUPPLEMENT ON THE SOFT ROT, GROWTH AND YIELD OF GINGER

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Abstract

Soft rot is a serious disease of all ginger growing areas in India and affect the rhizome production to the tune of 70 per cent. The soft rot is caused by a complex of fungus (*Pythium, Fusarium* and *Rhizactonia*), bacterium (*Ralstonia solanacearum*) and root knot nematode. This disease is a soil borne nature; hence, it is very difficult to control disease effectively without deteriorating environment. Experiments were conducted for three years, to find out the amicable solution to this devastating disease with integrated nutrient supplement trials with 12 treatments *viz.,* T_1- Vermicompost @ 20q/ha, T_2- Vermicompost @ 5.0q/ha, T_3- FYM @ 10.0t/ha + Vermicompost @ 10.0q/ha, T_4-FYM @ 5.0t/ha + Vermicompost @ 15.0 q/ha, T_5-FYM @ 15.0 t/ha + Vermicompost @ 5.0 q/ha, T_6- Recommended dose of fertilizer (NPK @ 120:80:80 Kg/ha), T_7- NPK @ 60:40:40 Kg/ha + FYM @10 t/ha + Vermicompost @ 5.0 q/ha + Azospirillum @ 5.0Kg/ha + Trichoderma viride @ 50.0g/Kg rhizome seed treatment, T_8- Control (without any nutrient supplement) were conducted during 2010-11 to 2012-13 at Vegetable Farm, N.D. University of Agril. & Tech. Kumarganj, Faizabad (U.P.), India. Integrated nutrient supplement was found very effective in reducing the disease 10.5 PDI in comparison to control 41.1 PDI. The same treatment showed highest increase of yield per cent (104.0) over the control. It also stands as best treatment from the point of not only reducing disease incidence, but also in high number of primary rhizome (4.3), secondary rhizome (5.6) and dry matter recovery (19.3%) from fresh rhizome ginger.

Key wards : Integrated nutrients management, soft rot, growth, yield, ginger.

Introduction

Ginger (*Zingiber officinale* Rosc) is one of the important commercial spice crops of India occupied first position in the world in term of production 772.2 thousand ton (Anonymous, 2012). Demand of ginger is increasing every year in the world market due to its diverse products and use (FAO, 2009). Among several factors affecting the ginger production, one of the prime factor is soft rot disease incidence. Soft rot is a serious disease of ginger in all ginger growing areas and affect the rhizome production to the tune of 70 per cent. Soft rot is caused by a complex of fungus (*Pythium* sp, *Fusarium* sp. and *Rhizoctonia* sp.), bacteria (*Ralstonia solanacearum*) and root knot nematode (Dohroo, 1991). The pathogen attack ginger rhizome separately and some time together. It is a soil borne nature, hence proper disease control is very difficult without deteriorating environment. Lack of soft rot resistant high yielding varieties and use of chemicals to control the disease is criticized throughout the world due to its hazardous effects on environments. Use of Farm yard manure (FYM), vermicompost and chemical fertilizers in an integrated nutrient supplement have improved the soil health and reduce the cost of cultivation with increased crop yield and quality of produce. Cow-dung manure and poultry manure have great tendency to increased growth and yield of ginger in rainforest zone (Eghuchua and Enujeke, 2013). Keeping in view, the present experiment was conducted to assess the effectiveness of FYM, vermicompost, bio-fertilizers and seed treatment with *Trichoderma viride* on soft rot disease, growth and yield of ginger (*Zingiber officinale*).

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Materials and Methods

The experiment was conducted three ginger growing seasons 2009-10 to 2011-12 at Vegetable Farm of N.D. University of Agril. & Tech., Kumarganj, Faizabad (U.P.), India. The soil was Alluvial with patchy usar, low in organic carbon, medium in phosphorus and potassium. The experiment was consist 12 treatments *viz*., T_1 = Vermicompost @ 20q/ha, T_2 = Vermicompost (@ 5q/ha, T_3 = FYM @ 10 t/ha + vermicompost @ 10. 0q/ha, T_4 = FYM @ 5.0 t/ha + vermicompost @ 15.0 q/ha, T_5 =

Table 1 : Effect of Integrated nutrients supplements on management of soft rot disease incidence and per cent yield increase of ginger.

Nutrient supplements	Percent disease intensity	Percent disease control	Percent yield increase/ha
T_1 = Vermicompost @ 20.oq/ha	18.6	54.7	28.9
T_2 = Vermicompost @ 5.0q/ha	20.4	50.3	21.1
T_3 = FYM @ 10t/ha + vermicompost @ 10.0q/ha	15.7	61.8	56.6
T_4 = FYM @ 5.0t/ha + vermicompost @ 15.0q/ha	17.5	57.4	34.8
T_5 = FYM @ 15t/ha + vermicompost @ 5.0q/ha	16.2	60.5	37.9
T_6 = Recommended NPK @ 120:80:80Kg/ha	24.1	41.2	80.5
T_7 = NPK @ 80:40:40Kg/ha+FYM@10t/ha+Vermicompost @ 5.0q/ha +*Azospirillum* @ 5.0 Kg/ha + *T.viride* @ 50g/kg seed treatment	10.5	74.6	104.0
T_8 = Control	41.1	-	-
SEm	2.02		
CD at 5%	6.12		
CV	16.76		

Table 2 : Effect of Integrated nutrients supplements on growth and yield of ginger.

Nutrient supplements	Plant height (cm)	No. leaves plant^{-1}	No. of tiller plant^{-1}	No. of primary rhizome plant^{-1}	No. of secondary rhizome plant^{-1}	Fresh yield (g) plant^{-1}	%dry matter recovery
T_1 = Vermicompost @ 20.0q/ha	99.7	18.6	8.6	2.6	3.2	149.8	16.5
T_2 = Vermicompost @ 5.0q/ha	95.1	18.3	8.8	2.6	3.0	147.8	16.9
T_3 = FYM @ 10t/ha + vermicompost @ 10.0q/ha	100.9	21.3	9.6	3.3	3.3	158.7	18.9
T_4 = FYM @ 5.0t/ha + vermicompost @ 15.0q/ha	101.2	21.6	9.6	3.3	3.6	151.1	17.4
T_5 = FYM @15t/ha + vermicompost @ 5.0q/ha	103.3	22.3	11.6	3.3	3.0	158.8	17.0
T_6 = Recommended NPK @ 120:80:80Kg/ha	118.8	30.0	15.3	3.6	5.3	166.0	16.5
T_7 =NPK @ 80:40:40Kg/ha+FYM @ 10t/ha+vermicompost @ 5.0q/ha + *Azospirillum* @ 5.0 Kg/ha + *T. viride* @ 5.0g/kg seed treatment	120.0	30.3	16.0	4.3	5.6	166.6	19.3
T_8 = Control	77.8	18.0	8.0	2.0	2.3	113.3	12.5
SEm	1.70	0.92	0.74	0.33	0.32	1.27	0.53
CD at 5%	5.17	2.79	2.25	1.00	0.96	3.84	1.62
CV	2.89	7.04	11.8	17.8	14.86	1.45	5.50

FYM @ 15 t/ha + vermicompost @ 5.0 q/ha, T_6 = RDF (120:80:80 Kg NPK/ha), T_7 = Integrated nutrient supplement (50% RDF + FYM @ 10t/ha + vermicompost @ 5.0 q/ha + *Azospirillum* @ 5 Kg/ha + seed treatment with *Trichoderma viride* 50g/Kg seed), T_8 = Control (without any supplement). The experiment was laid out in randomized block design with three replications in soft rot sick field. Rhizomes of ginger were sown in lines 30 × 20 cm apart by using uniform seed rate 20 t/ha. FYM, vermicompost and bio-fertilizers applied at the time of land preparation. 50% nitrogen, phosphorus and potash were incorporated at the time of sowing. The crop was sown in 1st week of June and harvested in the 3rd week of March in all three growing season. Other standard agronomical practices of ginger cultivation were adopted during the cropping period. Data of soft rot incidence was recorded by the formula-

$$\text{Per cent disease intensity} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

Results and Discussion

Soft rot of rhizome

The performance of integrated nutrient supplements (50 percent recommended dose of fertilizers + FYM @ 10t/ha + vermicompost @ 5.0q/ha + *Azospirillume* @ 5.0 kg/ha + seed treatment with *T. viride* @ 50g/kg seed) was found best treatment for management of soft rot disease incidence (74.6%) followed by FYM @ 10 t/ha + vermicompost @ 10.0q/ha (61.8%), FYM @ 15t/ha + vermicompost @ 1.25q/ha (60.5%) and FYM @ 5t/ha + vermicompost @ 15.0 q/ha (57.4%). In the first treatment, soil application of vermicompost alone @ 20.0 q/ha was recorded significantly lower disease incidence (18.6 PDI) in comparison to vermicompost alone @ 5.0 q/ha (20.0 PDI) and control (41.1 PDI) (table 1). Poudyal (2012) reported that Jeevatu based organic liquid manure was significantly played vital role in soft rot control and no further spreading of the disease was observed after the application of jeevatu based organic liquid manure in field. Seed treatment with *Trichoderma harzianum* and *Trichoderma viride* also gave satisfactory control of *Fusarium* wilt in coriander (Kumar and Ranganathan, 2000). The potentiality of *Trichoderma* spp. was found higher with adding organic manures in soil such as FYM for effective control of *Fusarium* wilt of cumin (Gangopadhyay and Gopal, 2010). Shanmugam *et al.* (1999) also reported that the combination of biological control agents with fungicides gave effective suppression of soft rot disease of ginger due to competition on space and absorption of nutrients, toxin produced by microbes, antifeeding effect and direct invasion on pathogenic microbes and killing etc.

Growth and yield

The pooled data (table 2) revealed that there was significant differential effects of integrated nutrients supplement and alone nutrient supplement through FYM and vermicompost on growth and yield of ginger. Application of integrated nutrients supplement recorded highest plant height, number of leaves, number of tiller/ plant and number of primary and secondary rhizome. Fresh yield was significantly higher over the rest of other treatments except recommended dose of fertilizers. Effect of recommended dose of fertilizer was more or less same with integrated nutrient supplement in case of number of primary, secondary rhizome and fresh yield. These results were supported by earlier findings of organic package of practices for ginger in north eastern region (Anonymous, 1999). All treatment increased the dry matter recovery of fresh rhizome (table 2). The highest dry matter recovery was recorded in an integrated nutrient supplements followed by FYM @ 10t/ha + vermicompost @ 10q/ha, FYM @ 5.0t/ha + vermicompost @ 15.0 q/ha and FYM @ 15.0t/ha + vermicompost @ 5.0 q/ha. The lowest dry matter recovery was found in vermicompost @ 5.q/ha and RDF. Poudyal (2012) also found better health and growth of ginger treated by organic liquid manure based jeevatu than the other treatments.

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