Influence of Plant Spacing, Seed Rhizome Size and Tree Canopy Environment on the Incidence of Rhizome Rot in Ginger

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ABSTRACT

Rhizome rot disease is one of the major production constraints of ginger cultivation in hill agro-ecological region of Arunachal Pradesh. Considering both lower percentage disease incidence and higher yield, attempts have been made with different trials to overcome. Plant spacing of 20×20 cm and 25×25 was found to be optimum for disease incidence (46.2 & 41.7 %) and crop yield (45.1 & 47.9 t/ha) in the region. Disease incidence was high in close spacing of 10×10 cm (55.3 %) and low in more spacing of 35×35 cm (34.6 %). seed rhizome size of 60 to 80 g was found to be optimum for ginger planting. The smallest rhizome size used for seed had better growth performance than mother rhizome which had an additive effect on incidence of rhizome rot of ginger. Ginger grown under two canopy environment showed higher growth performance and lower disease incidence than that of field environment. The lowest disease incidence (22.2 %) with highest yield (48.4 t/ha) of ginger was recorded in silvi-canopy environment, while highest disease incidence (40.3 %) with lowest yield (35.2 t/ha) was recorded in open field conditions.

Keywords: Ginger, rhizome rot, plant space, seed size, canopy

INTRODUCTION

Ginger (*Zingiber officinale*) is one of the oldest spices with a distinct flavor and pungency, used both as spice and medicine (Sharma et al., 2010). India is the largest producer of ginger in the world accounting 49% of ginger area and 72% of ginger production. North-eastern India has greater production in the county registering record productivity level in the world (5.8 t/ha as against national average of 3.7 t/ha), and is emerging as India's organic ginger hub (Rahman et al., 2009). Arunachal Pradesh, the largest state in the northeast India, has tremendous potential for commercial cultivation and production in the region and in particular, the Upper Siang district has ginger as major cash crop that is intercropped under the canopy of horti-silviulture systems, which is considered to be a sustainable land management system in the region. The well developed tree canopy and resultant shade make light as an important factor in determining the potential of understory crops (Osman et al. 2007). Nonetheless, a recent report reveal that the production of ginger is largely affected by diseases caused by bacteria, fungi, viruses, mycoplasma and nematodes (Dileep et al., 2013). For instance, rhizome rot caused by fungi is one of the important production constraints of ginger in the region (Sharma *et al*., 2010), as also bacterial wilt (*R. solanacearum*; Sarma and Anandaraj, 2000). In India, this disease is prevalent in most of the ginger growing areas and is responsible for losses to the extent of 50% or more (Joshi and Sharma, 1982). A successful management strategy without using chemical with alternative option of controlling/preventing rhizome rot of ginger (Pandey et al., 2010) is yet to be formulated. Nevertheless, the yield of ginger has been reported to vary greatly depending on cultivars, climate, planting time and maturity at harvest (Peter et al., 2005). Therefore, experiment was conducted to manage the rhizome rot by

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adjusting plant spacing, seed/rhizome size and as well as canopy of horti-silviculture system and result results there have been discussed in this paper.

MATERIALS AND METHODS

Field experiment was carried out during the year 2011 at Geku (28.1221° N and 94.3663° E), Upper Siang to study the influence of plant spacing, seed rhizome size and tree canopy environment on the incidence of rhizome rot of ginger. The planting was done as intercrop either under orchard (orange) or natural forest (silvi). The areas are hilly slope with rainfed conditions possessing well drained lateritic and red loamy type soil with several rocky patches. For investigation, six different plant spacing (10×10, 15×15, 20×20, 25×25, 30×30 and 35×35 cm), six different size of seed rhizome (20, 40, 60, 80, 100 and 120 gm) and three different environmental conditions viz., two under canopy environment of orchard, natural forest area (herbaceous plants were removed), and open field condition (3×2 m) with three replications were considered. In case of 120 gm seed rhizome size, mother rhizome was also used, this is commonly practiced by the ginger grower in the area. Three trials were used for the screening against rhizome rot of ginger. The experiments were laid out in a complete randomized block design for all the three experiments.

The disease appearances on ginger plant were recorded as per cent disease incidence (PDI) by counting the number of plants affected per plot divided by total number of plants in each plot multiplied by 100. Observations in respect of disease incidence were recorded periodically at monthly intervals and the yield data was recorded at harvest.

RESULTS AND DISCUSSION

Ginger is one of the main cash crops cultivated throughout the hilly slope of the region. The crop production has been minimized due to pathological problem mainly by rhizome rot. Attempts with different plant spacing, seed rhizome size and as well as canopy environment of horti-silvi trees. Plant spacing showed differential disease incidence and the differences were found to be statistically significant (Table 1). Maximum disease incidence (55.3%) was observed in 10×10 cm plant spacing and minimum in 30×30 cm plant spacing (34.6%). Likewise, productivity was contrary with maximum yield in wider spacing of 30×30 cm (53.6 t/ha) that was statistically at par with 35×35 cm plant spacing (50.1 t/ha), while minimum yield was obtained in closer spacing of 10×10 cm (28.7 t/ha). It was also observed that with decreasing plant spacing there has been a significant increase in per cent disease incidence. This shows that wider plant spacing had sufficient gap to avoid contact thus, have significant difference in disease incidence and rhizome yield. It may also be concluded that 20×20 cm and 25×25 cm plant spacing seems to be optimum for better crop return and lower disease incidence (Sharma et al., 2012).

Table 1: Effect of different plant spacing on rhizome rots incidence and yield of ginger.

Treatment	Plant spacing (cm)	Disease incidence (%)	Yield (t/ha)
T1	10×10	55.3	28.7
T2	15×15	51.9	37.6
T3	20×20	46.2	45.1
T4	25×25	41.7	47.9
T5	30×30	36.4	53.6
T6	35×35	34.6	50.1
SEM (±)		1.74	1.83
C.D. (p=0.05)		4.18	3.05

The selection of rhizome size (on weight basis) as planting material have equal role in contributing disease incidence and yield potential in ginger. But the differences in disease incidence percentage were not statistically significant except in case of farmers' practice (T 6) (Table 2). Lowest disease incidence (32.7%) was observed when planting was

Table 2. Effect of different seed rhizome size of ginger on rhizome rot and yield of ginger

Treatment	Rhizome size (gm)	Disease incidence (%)	Yield (t/ha)
T1	20	32.7	39.5
T2	40	36.9	41.8
T3	60	40.6	50.0
T4	80	43.7	54.2
T5	100	48.2	47.2
T6	120	61.1	10.6
SEM (±)		3.04	1.40
C.D. (p=0.05)		6.50	3.18

Table 3. Effect of canopy environment on rhizome rot and yield of ginger argi-hort-silvi system.

Conditions	Disease observation			Yield (t/ha)
	Yellow leaves/ Plant	Plant death/ Rhizome	Disease incidence (%)	
Orange canopy environment	6.4	1.8	28.4	46.5
Silvi canopy environment	3.6	1.5	22.2	48.4
Field environment	11.7	4.2	40.3	35.2
SEM (±)	5.2	3.1	3.7	1.2
CD (P=0.05)	1.4	2.7	1.7	3.4

made with 20 gm seed rhizome and highest rhizome yield was observed when planting was made with 80 g seed rhizome (54.2 t/ha). Thus, from the present investigation it can be concluded that considering both the lower percentage of disease incidence and higher yield, 60-80 gm seed rhizome size was found optimum for ginger planting. It was also observed that extraction of mother rhizome as practiced by the farmers had an additive effect on incidence of rhizome rot disease of ginger (Sharma et al., 2012).

The environmental conditions of horti-silvicultural canopy also have equally importance in influencing crop production and disease prevalence. The data clearly shows that crop grown under horti-silvi canopy were significantly better than in the open field (Table 3). The initial appearance of disease on the leaves/plant (3.6), plant death/rhizome (1.5) and per cent disease incidence (22.2 %) was recorded lowest in silvi-canopy environment that was statistically at par with orchard canopy environment, while highest disease incidence was recorded field environment (11.7, 4.2 and 40.3 %). The environment under silvi-canopy also encouraged greater productivity of ginger (48.4 t/ha) that was statistically at par with orchard canopy environment (46.5 t/ha), while lowest yield was recorded in field environment (35.2 t/ha). Over all, it could be concluded that tree-canopy had a positive role in enhancing ginger productivity in the humid tropical region of Arunachal Pradesh, northeast India.

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