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Research Article

SCREENING OF GINGER GERMPLASMS AGAINST RHIZOME ROT DISEASE COMPLEX IN MID HILL CONDITION OF NEPAL

Basistha Acharya¹ and Ram B. Khadka²

ABSTRACT

Ginger (*Zingiber officinale*) is one of the major spice crops of Nepal. Rhizome rot disease complex is an important production constraint. The search of resistant source for this disease is still at infant stage in Nepal. In the present study, Forty-two ginger germplasm collected from different locations were screened against rhizome rot complex in sick plot of Ginger Research Programme, Kapurkot, Salyan during the ginger growing season of 2012/13-2013/14. The indicator such as percent disease incidence, fresh rhizome yield, diseased and healthy rhizome number were taken to evaluate the resistance and tolerance of the germ-plasms under optimum disease conditions. Varied level of resistance and tolerance were observed among the tested germplasms. The percent disease incidence was ranged from 22.76 to 71.99 % while healthy rhizome yield and diseased rhizome percentage was varied from 11.5 to 150 gm per plant and 2.4 % to 57.85% respectively. Out of the 42 germplasms screened against rhizome rot disease complex, none of them was found to be resistant and moderately resistant however, 20 moderately susceptible (PDI-21 to 50 %) and 22 highly susceptible (PDI - above 50 %) were recorded. Germ-plasm ZI 1017 was found to be comparatively resistant with lowest percentage disease incidence (22.76%), highest healthy rhizome per plant (101.1gm) and lowest diseased rhizome yield percentage (4.36%).

Key words: Fusarium, ginger, pythium, resistant and rhizome rot complex

INTRODUCTION

Ginger (*Zingiber officinale* Rosc.) is one of the major spice crops of Nepal and an important spice crop all over the world. In Nepal it is being grown in about 42% (20,256 ha) of total major spices cultivated area (19,376 ha) and the production was recorded 2, 35,033 mt with the productivity of 12.13 mt/ha (ABPSD, 2012/13). Ginger has significant contribution on national economy of the country as it an exportable commodity. It is a major cash crop to the large numbers of farmers of hill region. It is used as condiment, flavoring agent, in the preparation of non-alcoholic beverage. It is also known to have numerous medicinal

¹ Technical Officer, National Ginger Research Programme, Kapurkot

² Scientist, Regional Agricultural Research Station, Khajura
Email for correspondence: basisthacharya1@gmail.com

properties such as a carminative, an aromatic stimulant to the gastrointestinal tract, externally as a rubefacient and counter irritant. Nepal is globally third largest ginger producer country (FAOSTAT, 2012). However, due to unavailability of high yielding, disease resistant varieties and lack of appropriate cultural practices the productivity is not satisfactory at farmers field level (GRP, 2012). Loss due to disease is an important production constraint for ginger in Nepal.

Ginger is affected by many diseases (Iyer, 1988), of them, rhizome rot complex caused by *Pythium* spp. and *Fusarium* spp. is of economic importance and most devastating one causing colossal damage. In Nepal average estimated yield loss of 20% was found due to Rhizome rot complex (Sharma *et al.*, 1998). According to Anonymous 2011, 70% rhizome may be reduce due to soft rot infestation in Nepal. The two diseases, soft rot and yellows are generally found together in the same field affecting the same plant parts and their symptoms often get mixed up. The term "rhizome rot" is generally accepted for soft rot and yellows disease complex (Mathur, 2000). Soft rot is caused mostly by *Pythium aphanidermatum* (Sharma, 1994) and yellows disease is caused mostly by *Fusarium oxysporium* f.sp. *zingiberi* (Mathur, 2000). It was reported that six species of *Pythium* (*P. aphanidermatum*, *P. deliense*, *P. myriotylum*, *P. pleroticum*, *P. vexans* and *P. ultimum*) and three species of *Fusarium* (*F. oxysporum*, *F. solani*, *F. equiseti*) were responsible for rhizome rot complex (Sharma, 1994; Lodha and Mathur, 1996). Chemical control of this pathogen is not practical because of high cost and possessing environmental pollution and hazardous effect. Therefore use of resistant variety is the best alternatives to manage the disease. Keeping this in view, Ginger Research Program (GRP) started screening of available germplasms against the rhizome rot disease in search of resistant variety. In the present study forty-two ginger germplasms were screened against rhizome rot disease complex.

MATERIALS AND METHODS

A total of forty-two ginger germplasms collected from major ginger growing districts viz. Salyan, Rukum, Pyuthan, Palpa, Dang, Syanja, Kailali, Nawalparasi, Dhankuta, Bhojpur, Morang, Illam, Gulmi, Gorkha, Surkhet, Dhading, Udyapur and Saptari of Nepal (Table 1) were screened in naturally infested sick plot at GRP, Salyan during two consecutive years of 2012/13- 2013/14. Disease free seed rhizomes bits of about 50 gm were used for planting. Experiment was laid out in an augmented (rod row) design in a single row of three meter length. The disease free rhizomes weighing about 50 gm were planted 30 cm apart both from line to line and plant to plant in a single row of 3 meter length. Both organic and inorganic fertilizer were applied @ FYM 30 mt/ha and N:P₂O₅:K₂O @ 75: 50: 50 kg/ha respectively but no fungicides were applied. Rigorous care was taken during the crop period. Mulching with Pine sticks was given immediately after planting and manual weeding was done immediately after germination, 30 and 60 days after germination (DAG) respectively. Observations were taken as percent disease incidence (PDI) by counting the number of plants affected per row/plot divided by total no of plants in each row multiplied by 100 as using the formula,

$$\text{Disease Incidence (\%)} = \frac{\text{Number of infected Plants}}{\text{Total Number of the Plants}} \times 100$$

First observation was done at tiller initiation stage (after four month of sowing) while second and third observation were done at active tillering (fifteen days after first observation) and at the beginning of rhizome bulking stage (fifteen days after second observation). Mean of three observations were considered for mean PDI of each varieties. Two years' pooled mean PDI was used to group the varieties in four different categories such as resistant (PDI- 0-5%), moderately resistant (PDI 6-20%), moderately susceptible (PDI 21-50%), and highly susceptible (PDI >50%) (Bhai, 2013). All the genotypes were harvested at a time when leaves and pseudo stems became dry and fallen down. The observations on yield attributing characteristics such as plant stand, tillers per clump, diseased rhizome yield, plant height and fresh rhizome yield were recorded. Varieties were randomly allocated to the plots in both the years. Data were analyzed using the statistical package MSTAT-C (Russel and Eisensmith, 1983).

RESULTS AND DISCUSSION

The mean PDI of rhizome rot was 43.61% in 2012/13 while 57.90% in 2013/14 (Table 2). As in the year 2013/14 due to heavy rainfall causing soil saturation and flooded conditions the percentage of disease incidence might have increased (Table 5). Out of the 42 germplasms screened against rhizome rot disease complex, none of them was found to be resistant. The varied level of resistance and tolerance were observed among the tested germplasms. During the year 2012/13 the percent disease incidence was recorded lowest in

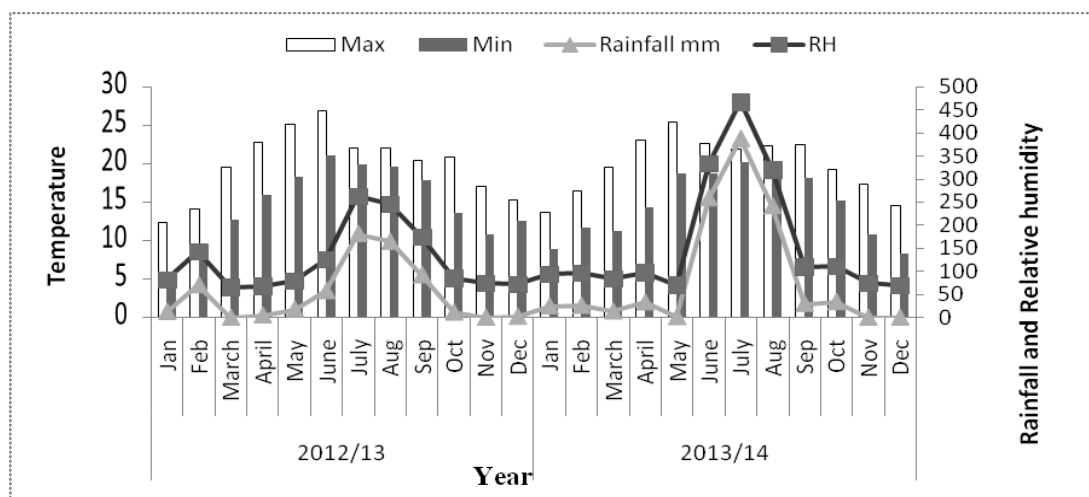


Fig. 1 : Monthly Agro-meteorological Data at GRP Kapurkot, Salyan (1480 masl) during 2012/13 - 2013/14.

in the germplasm, Selection (11.11%) but the germplasm ZI 1011 (16.10%) recorded lowest percentage disease incidence during the year 2013/14. The pooled data of two year revealed that the lowest percentage disease incidence was recorded on germplasm, ZI 1017. Pooled data revealed that 47.61 % of the germplasms showed moderately susceptible reaction with having PDI 21-50% and 52.38% of the germplasms showed highly susceptible reaction (>50% PDI). Among the tested germplasms ZI 1025 (45.73%), ZI 0517 (39.30%), ZI 8506 (44.55%), ZI 1013 (43.35%), ZI 1023 (34.09%), ZI 0405 (48.61%), Selection (38.06%), ZI 0511 (44.47%), ZI 1015 (49.40%), ZI 0301 (47.80%), ZI 0506 (47.80%), ZI 1008 (48.75%), ZI 1009 (38.87%), ZI 1001 (47.30%), KK-1 (47.22%), ZI 1011 (24.72%), ZI 1002(46.61%), ZI 1016 (30.65%), ZI 1019 (46.90%), ZI 1017 (22.76%) were found to be moderately susceptible, ZI 1006 (56.50%), ZI 1012 (54.58%), ZI 1003 (68.35%), ZI 1027 (52.87%), ZI 1007 (63.28%), ZI 1010(52.50%), ZI 1020 (63.87%), ZI 8503(64.77%), ZI 1101 (62.50%), ZI 0513(50.02%), ZI 0512 (59.70%), ZI 8504 (61.14%), ZI 1014 (67.34%), ZI 0403 (56.25%), ZI 8502 (52.50%), ZI 9702 (71.99%), ZI 1005 (60.70%), ZI 1028 (56.19%), ZI 1021 (52.95%), ZI 1004 (53.15%), ZI 1024 (59.20%), ZI 1029 (52.40%) were found to be highly susceptible (HS) in pooled data of two years 2012/13 and 2013/14 .

Pooled data of two years, (Table 3) showed disease incidence range 22.76 to 71.99 % with healthy and diseased rhizome yield of 11.5 to 150 gm per plant and 2.4 to 57.85 % respectively. Highest healthy rhizome yield (150gm/plant) with lowest disease rhizome yield (2.40 %) and disease incidence (34.09%) was observed in the germplasm, ZI 1023 (collected from Dhankuta district). Tillers/clump was found highest (4.65) on ZI 1028 and highest plant height (63.75cm) was recorded on genotype ZI 8503 (collected from Bhojpur district). Germplasm ZI 1017 (collected from Udyapur district) was found to be comparatively resistant (nearly resistant) with lowest percentage disease incidence (22.76 %), higher healthy rhizome per plant (101.1gm/plant) and lower diseased rhizome yield (4.36 %). The different parameters (plant stand, tiller, plant height, FRY, DRY) of screened ginger genotypes is presented on table 3. All the 42 ginger germplasm screened were grouped into four categories based on disease incidence and presented in table 4.

Table 1. Collected ginger germplasms used in screening against rhizome rot disease complex.

S.N.	Germplasm	Previous Name	Collected site	Collected Year (AD)
1.	ZI 1006	Salyan	Badagaun-4, Salyan	2010
2.	ZI 1012	Rukum	Rupha-2, Rukum	2010
3.	ZI 1003	Pyuthan	Baddada, Pyuthan	2010
4.	ZI 1027	Palpa	Khasauli-6, Palpa	2010
5.	ZI 1007	Dang	Hapur, Dang	2010
6.	ZI 1025	Syanja	Aalamdevi-2, Syangja	2010
7.	ZI 0517	Kailali	Kailali	2005
8.	ZI 8506	Nawalparasi	Dhaubadi, Nawalparasi	1985

S.N.	Germplasm	Previous Name	Collected site	Collected Year (AD)
9.	ZI 1013	Syangja	Putalibazar, Syangja	2010
10	ZI 1010	Salyan	Kotbara-6, Salyan	2010
11.	ZI 1023	Dhankuta	Dhulikharkha-6, Dhankuta	2010
12.	ZI 0405	Syangja	Kuwakot, Syangja	2004
13.	Selection	Selection	Selected from mix germplasm	-
14.	ZI 0511	Salyan	Phalabang-4, Salyan	2005
15.	ZI 1020	Dhankuta	Dhulikharkha-6, Dhankuta	2010
16.	ZI 8503	Bhojpur	Hontang, Bhojpur	1985
17.	ZI 1101	PatleDhankuta	Paripatle, Dhankuta	2010
18.	ZI 1015	Saptari	Kanchapur, Saptari	2010
19.	ZI 0301	Gorubathane	-	2003
20.	ZI 0513	Saptari	Dharampur-7, Saptari	2005
21.	ZI 0512	Udyapur	Beltar, Udyapur	2005
22.	ZI 8504	Syanja 'Old'	Kolma, Syanja	1985
23.	ZI 0506	Dhading	Jibanpur-9, Dhading	2005
24.	ZI 1008	Dang	Kamerichaur, Dang	2010
25.	ZI 1009	Dang	Sirubari, Dang	2010
26.	ZI 1014	Rukum	Khalanga-2, Rukum	2010
27.	ZI 1001	Surkhet	Surkhet	2010
28.	ZI 0403	Gorkha	Gorkha	2004
29.	KK-1	ZI 9721	Malneta, Salyan	1997
30.	ZI 8502	Illam 'Old'	Jirmale, Illam	1985
31.	ZI 9702	Parbat	Parvat	1997
32.	ZI 1005	Jajarkot	Khalanga-6, Jajarkot	2010
33.	ZI 1028	-	-	2010
34.	ZI 1011	Salyan	Kotbara-6, Salyan	2010
35.	ZI 1021	Siraha	Sarsor, Siraha	2010
36.	ZI 1002	Rolpa	Jhenam-5, Rolpa	2010
37.	ZI 1004	Jajarkot	Khalanga-5, Jajarkot	2010
38.	ZI 1016	Morang	Morang	2010
39.	ZI 1024	Gulmi	Thanapati-9, Gulmi	2010
40.	ZI 1019	Udyapur	Tribini, Udyapur	2010
41.	ZI 1029	-	-	2010
42.	ZI 1017	Udyapur	Jalpa, Udyapur	2010

Table 2. Evaluation and screening of ginger germplasms against rhizome rot disease complex at GRP, Kapurkot, Salyan during 2012/2013 – 2013/14.

S.N	Germplasm	Plant Stand		Mean Tiller/clump		Mean Plant height (cm)		HRY (gm/plant)		DRY (%)		Disease Incidence %	
		012/13	013/14	012/13	013/14	012/13	013/14	012/13	013/14	012/13	013/14	012/13	013/14
1	ZI 1006	3.00	4.00	4.50	2.40	50.00	21.00	100.00	37.50	17.54	11.80	50.00	63.00
2	ZI 1012	9.00	7.00	6.50	2.00	68.40	29.20	53.33	24.30	12.12	10.50	55.56	53.60
3	ZI 1003	9.00	7.00	5.40	3.60	62.60	43.60	100.00	21.40	11.02	9.10	70.00	66.70
4	ZI 1027	8.00	8.00	5.30	1.40	71.20	27.40	52.50	28.70	14.77	6.20	57.14	48.60
5	ZI 1007	9.00	9.00	5.50	2.40	63.20	23.80	68.88	118.90	25.20	2.70	55.56	71.00
6	ZI 1025	8.00	10.00	5.40	2.80	72.30	38.40	53.75	41.00	33.33	6.80	55.56	35.90
7	ZI 0517	9.00	8.00	5.20	2.00	81.40	29.20	158.88	36.90	4.09	34.10	30.00	48.60
8	ZI 8506	10.00	10.00	3.80	1.60	74.30	26.60	66.66	17.00	9.88	19.05	25.00	64.10
9	ZI 1013	8.00	9.00	5.50	3.20	71.40	42.00	66.66	52.20	7.41	12.90	20.00	66.70
10	ZI 1010	10.00	10.00	4.80	1.80	75.40	36.40	113.00	13.00	20.13	38.10	40.00	65.00
11	ZI 1023	10.00	9.00	5.30	2.20	58.60	42.60	200.00	100.00	2.60	2.20	18.18	50.00
12	ZI 0405	9.00	6.00	7.00	1.40	70.00	36.40	33.33	45.00	11.36	30.80	22.22	75.00
13	Selection	9.00	10.00	5.00	1.60	60.00	31.00	82.50	23.00	16.50	25.80	11.11	65.00
14	ZI 0511	6.00	9.00	5.50	1.60	57.60	32.40	68.33	47.80	8.77	4.40	33.33	55.60
15	ZI 1020	6.00	9.00	4.50	2.00	58.60	25.00	52.85	27.20	1.89	28.90	71.43	56.30
16	ZI 8503	8.00	4.00	5.00	1.60	80.30	47.20	101.42	10.00	10.47	11.10	57.14	72.40
17	ZI 1001	9.00	10.00	5.30	2.80	74.60	26.80	67.14	26.00	10.13	31.60	62.50	62.50
18	ZI 1015	9.00	8.00	5.20	1.20	57.60	20.00	57.77	18.70	11.34	25.00	30.00	68.80
19	ZI 0301	10.00	10.00	4.60	2.80	64.60	34.00	70.00	55.00	6.98	3.50	40.00	55.60
20	ZI 0513	3.00	7.00	4.80	2.20	62.30	37.20	0.00	22.90	100.00	15.70	33.33	66.70
21	ZI 0512	9.00	9.00	5.60	2.20	68.30	34.00	54.28	70.00	18.46	10.00	50.00	69.40
22	ZI 8504	9.00	7.00	4.30	1.40	62.10	26.20	55.00	74.30	10.71	3.70	66.67	55.60

S.N	Germplasm	Plant Stand		Mean Tiller/clump		Mean Plant height (cm)		HRV (gm/plant)		DRY (%)		Disease Incidence %	
		012/13	013/14	012/13	013/14	012/13	013/14	012/13	013/14	012/13	013/14	012/13	013/14
23	ZI 050	7.00	9.00	4.50	1.80	66.70	31.60	28.00	20.00	9.09	18.20	40.00	55.60
24	ZI 1008	9.00	10.00	5.50	1.80	69.30	38.00	76.66	23.00	23.68	8.00	30.00	67.50
25	ZI 1009	5.00	9.00	5.20	2.20	55.00	32.60	28.33	23.30	26.67	8.70	33.33	44.40
26	ZI 1014	4.00	4.00	5.40	2.00	48.30	22.20	10.00	19.20	16.67	11.50	66.67	68.00
27	ZI 1001	5.00	4.00	5.50	2.20	78.60	33.00	116.00	25.00	17.53	16.70	60.00	34.60
28	ZI 0403	3.00	6.00	4.60	2.20	56.20	27.40	10.00	15.00	42.86	14.30	50.00	62.50
29	KK-1	8.00	9.00	5.00	2.40	68.30	30.80	81.11	20.00	13.33	40.00	33.33	61.10
30	ZI 8502	6.00	10.00	5.20	2.40	79.30	35.60	50.00	27.00	16.67	6.90	40.00	65.00
31	ZI 9702	5.00	2.00	5.30	2.00	69.40	23.00	10.00	15.00	37.50	14.00	60.67	83.30
32	ZI 1005	4.00	8.00	7.50	1.40	81.00	34.00	65.00	12.40	16.67	22.20	50.00	71.40
33	ZI 1028	6.00	8.00	5.50	3.80	58.20	27.40	20.00	25.00	7.14	33.30	66.67	45.70
34	ZI 1011	9.00	10.00	4.00	3.00	57.60	27.00	46.00	16.00	19.35	11.10	33.33	16.10
35	ZI 1021	6.00	5.00	4.50	2.00	57.40	14.80	34.28	10.40	11.90	25.00	50.00	55.90
36	ZI 1002	9.00	7.00	5.00	1.60	69.30	33.80	106.20	32.90	13.49	8.00	22.22	71.00
37	ZI 1004	10.00	10.00	4.50	3.60	76.30	31.20	95.00	26.00	12.24	7.10	30.00	76.30
38	ZI 1016	10.00	8.00	4.30	2.20	61.40	28.60	89.00	93.70	9.27	2.60	30.00	31.30
39	ZI 1024	10.00	8.00	3.70	2.40	68.40	26.60	130.00	12.60	9.88	30.80	50.00	68.40
40	ZI 1019	7	9	5.2	2.4	58.3	25	54.28	16.7	11.48	11.8	37.5	56.3
41	ZI 1029	9	7	6.3	2.4	51.2	28.6	47.5	24.3	8.77	2.9	50	54.8
42	ZI 1017	10	9	4.2	3.4	56.4	33.8	101.11	101.1	6.62	2.1	11.11	34.4
	Max	10	10	7.5	3.8	81.40	47.2	200.00	118.9	100	40	71.43	83.3
	Min	3	2	3.7	1.2	48.3	14.8	0	10	1.89	2.1	11.11	16.1
	SD	2.21	2.058	0.76	0.64	8.86	6.71	40.28	26.99	15.75	10.97	16.49	13.71

*HRV –Healthy Rhizome Yield, DRY- Disease Rhizome Yield

Table 3. Pooled data of different parameters on evaluation of Ginger germplasm against rhizome rot disease at GRP, Kapurkot, Salyan during 2012/2013 –2013/14.

S.N.	Germplasm	Plant Stand	Tiller/clump	Plant height (cm)	HRV (gm/plant)	DRY (%)	Disease incidence %
1	ZI 1006	3.50	3.45	35.50	68.80	14.67	56.50
2	ZI 1012	8.00	4.25	48.80	38.80	11.31	54.58
3	ZI 1003	8.00	4.50	53.10	60.70	10.06	68.35
4	ZI 1027	8.00	3.35	49.30	40.60	10.49	52.87
5	ZI 1007	9.00	3.95	43.50	93.90	13.95	63.28
6	ZI 1025	9.00	4.10	55.35	47.40	20.07	45.73
7	ZI 0517	8.50	3.60	55.30	97.90	19.10	39.30
8	ZI 8506	10.00	2.70	50.45	41.80	14.47	44.55
9	ZI 1013	8.50	4.35	56.70	59.40	10.16	43.35
10	ZI 1010	10.00	3.30	55.90	63.00	29.12	52.50
11	ZI 1023	9.50	3.75	50.60	150.00	2.40	34.09
12	ZI 0405	7.50	4.20	53.20	39.20	21.08	48.61
13	Selection	9.50	3.30	45.50	52.80	21.15	38.06
14	ZI 0511	7.50	3.55	45.00	58.10	6.59	44.47
15	ZI 1020	7.50	3.25	41.80	40.00	15.40	63.87
16	ZI 8503	6.00	3.30	63.75	55.70	10.79	64.77
17	ZI 1001	9.50	4.05	50.70	46.60	20.87	62.50
18	ZI 1015	8.50	3.20	38.80	38.20	18.17	49.40
19	ZI 0301	10.00	3.70	49.30	62.50	5.24	47.80
20	ZI 0513	5.00	3.50	49.75	11.50	57.85	50.02
21	ZI 0512	9.00	3.90	51.15	62.10	14.23	59.70
22	ZI 8504	8.00	2.85	44.15	64.70	7.21	61.14
23	ZI 0506	8.00	3.15	49.15	24.00	13.65	47.80
24	ZI 1008	9.50	3.65	53.65	49.80	15.84	48.75
25	ZI 1009	7.00	3.70	43.80	25.80	17.69	38.87
26	ZI 1014	4.00	3.70	35.25	14.60	14.09	67.34
27	ZI 1001	4.50	3.85	55.80	70.50	17.12	47.30
28	ZI 0403	4.50	3.40	41.80	12.50	28.58	56.25
29	KK-1	8.50	3.70	49.55	50.60	26.67	47.22
30	ZI 8502	8.00	3.80	57.45	38.50	11.79	52.50
31	ZI 9702	3.50	3.65	46.20	12.50	25.75	71.99
32	ZI 1005	6.00	4.45	57.50	38.70	19.44	60.70
33	ZI 1028	7.00	4.65	42.80	22.50	20.22	56.19
34	ZI 1011	9.50	3.50	42.30	31.00	15.23	24.72
35	ZI 1021	5.50	3.25	36.10	22.30	18.45	52.95
36	ZI 1002	8.00	3.30	51.55	69.60	10.75	46.61

S.N.	Germplasm	Plant Stand	Tiller/clump	Plant height (cm)	HRY (gm/plant)	DRY (%)	Disease incidence %
37	ZI 1004	10.00	4.05	53.75	60.50	9.67	53.15
38	ZI 1016	9.00	3.25	45.00	91.40	5.94	30.65
39	ZI 1024	9.00	3.05	47.50	71.30	20.34	59.20
40	ZI 1019	8.00	3.80	41.65	35.50	11.64	46.90
41	ZI 1029	8.00	4.35	39.90	35.90	5.84	52.40
42	ZI 1017	9.50	3.80	45.10	101.10	4.36	22.76
	Max	10.00	4.65	63.75	150.00	57.85	71.99
	Min	3.50	2.70	35.25	11.50	2.40	22.76
	SD	1.85	0.45	6.59	27.57	9.29	11.05

*HRY –Healthy Rhizome Yield, DRY- Disease Rhizome Yield, SD-Standard Deviation

Table 4. Ginger germplasm category based on percentage disease incidence

Rating scale	Germplasm	Reaction category
1 (0-5 % infection)	-	Resistant (R)
2 (6- 20 % infection)	-	ModeratelyResistant (MR)
3 (21-50% infection)	ZI 1025, ZI 0517, ZI 8506, ZI 1013, ZI 1023, ZI 0405, Selection, ZI 0511, ZI 1015, ZI 0301, ZI 0506, ZI 1008, ZI 1009, ZI 1009, ZI 1001, KK-1, ZI 1011, ZI 1002, ZI 1016, ZI 1019, ZI 1017	Moderately Susceptible (MS)
4 (>50% infection)	ZI 1006, ZI 1012, ZI 1003, ZI 1027, ZI 1007, ZI 1010, ZI 1020, ZI 8503, ZI 1101, ZI 0513, ZI 0512, ZI 8504, ZI 1014, ZI 0403, ZI 8502, ZI 9702, ZI 1005, ZI 1028, ZI 1021, ZI 1004, ZI 1024, ZI 1029.	Highly Susceptible (HS)

CONCLUSION

Rhizome rot disease complex in ginger crop is causing the heavy loss every year in the major Ginger growing areas of mid hill regions of Nepal. From this study germplasm ZI 1017 from Udaypur was found to be nearly resistant with comparatively lowest disease incidence, higher healthy rhizome yield per plant and lower diseased rhizome yield. At the same time moderately resistant germplasms identified in the experiment with good yield could be used in integration with other promising rhizome rot management options to minimize yield loss caused by rhizome rot disease. However, major causal organism responsible for rhizome rot disease in the locality need to be identified.

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