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Field Screening of Lentil Genotypes against Aphid Infestation in Inner Tarai of Nepal

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ABSTRACT

Twenty lentil (*Lens culinaris* Medik) genotypes received from Grain Legumes Research Program, Khajura, Banke were screened for relative tolerance against aphid (*Aphis craccivora* Koch.) at the research field of National Maize Research Program, Rampur, Chitwan during winter seasons of two consecutive years 2016 and 2017. The design of the experiment was Randomized Complete Block having three replications. The unit plot size was 4m × 1 m with 25cm row to row spacing and continue plant to plant spacing was maintained and net harvested plot was 4 square meters. The recommended dose of fertilizer was 20:40:20 N:P_2O_5:K_2O kg/ha and seed rate 30 kg/ha. Insect data were collected based on aphid population found at apical twigs (10 cm) per plant and scoring was done during flowering and pod formation stage. The grain yield was recorded. All screened genotypes differed significantly ($p<0.05$) on aphid population and grain yield. Genotypes, ILL 9924, RL 83, ILL 10856, ILL 6458 and RL 67 were less susceptible with higher grain yield. These results have important implications for the development of aphid tolerant high yielding lentil variety in inner Tarai of Nepal.

Keywords: *Aphis craccivora*, damage, host tolerance, lentil

सारांश

लाही किरा कम लाग्ने तथा यसको आक्रमण सहन सक्ने जातहरुको छनोट तथा बिकासको लागि कोसेबाली अनुसन्धान कार्यक्रम, खजुरा, बाँके बाट प्राप्त २० वटा मसुरोको जातहरुलाई लगातार सन् २०१६ र २०१७ को हिउदमा राष्ट्रिय मकैबालि अनुसन्धान कार्यक्रम, रामपुर, चितवनको अनुसन्धान ब्लकमा लगाई परिक्षणहरु संचालन गरिएको थियो । परिक्षणहरुलाई पूर्ण रेन्डोमाइज्ड ब्लक ढांचामा तिन पटक व्यबस्थित गरिएको थियो । प्रत्येक मसुरोको जातहरुलाइ चार बर्ग मिटरको प्लटहरुमा, एक लाइन देखि अर्को लाइन बिचको दुरी २५ से.मि. तथा बिरुवा देखि बिरुवा बीचको दुरी लगातार कायम हुने गरि लगाइएको थियो । मलखादको मात्रा २०:४०:२० नाइट्रोजन : फस्फोरस : पोटाश के.जी./हे. तथा बिउ दर ३० के.जी./हे. कायम गरिएको थियो । मसुरोको फुल फुल्ने र कोशा लाग्ने अवस्थामा प्रत्येक बिरुवाको टुप्पोमा दस से.मि. सम्म लाही किराको संख्या मापन साथै उत्पादन आंकडा पनि रेकर्ड गरिएको थियो । लाही किराको संख्या, क्षतीको मापन साथै अन्य उत्पादन सम्बन्धि आंकडाहरुको विश्लेषण गर्दा, आइ.एल.एल. ९९२४, आर.एल.८३, आइ.एल.एल.१०८५६, आइ.एल.एल.७४५८ र आर.एल.६७ जातहरु लाही किराको आक्रमण सहन सक्ने, क्षती कम हुने साथै उच्च उत्पादन दिने मसुरोको जातहरुको रुपमा पाइयो । यस परिक्षण बाट प्राप्त नतिजाहरु, नेपालको भित्रि मधेश क्षेत्रमा लाही किराको आक्रमण सहन सक्ने साथै उच्च उत्पादन दिने मसुरो जातहरुको रुपमा बिकाश गर्नको लागि उपयोगी हुनेछ ।

INTRODUCTION

Lentil (*Lens culinaris* Medik) is one of the most important cool seasons, annual grain legume or "pulse crop" that is considered a cousin of the bean. It is a self-pollinated, diploid (2n=14), which belongs to the family leguminosae and subfamily papilionoidae. The major lentil growing countries in South Asia are India, Nepal, Bangladesh and Pakistan. It is highly commercialized pulse crops among the grain legumes in terms of area (206969 ha), production (254308t) and productivity (1229 kg/ha), which shares almost 62% of total area and 65% of total production of pulses and also rates the higher

consumer preference in Nepal (MoALD 2017). In Nepal, there are unique and nutrition rich lentil landraces (Joshi et al 2019), but the productivity of lentil is low, one of the major regions for low productivity is significant damage caused by various insect pests. About three dozen insect pests have been reported to infest lentil under field and storage condition (Hariri and Tahhan 1983) out of which 21 species have been reported in India and South Asian region (Lal 1992). However, only some of these are economically important and require control measures. The field insect pests include aphids, cutworms, thrips, bud weevil, pod borer and in storage, species of seed beetles *Bruchus* and *Callosobruchus* spp. can cause severe damage in lentil (GLRP 2012). Among the insects, aphid is most serious, damaging and emerging pests for lentil crop. Sometimes it can cause total failure of production and damages the crop direct through by sucking cell sap. Aphids are able to multiply quickly that a moderate infestation can become a damaging population in less than a week (GLRP 2014). Aphids damage the lentil mostly by sucking sap but are also responsible for the transmission of viruses. Aphids heavily fed plants upon are stunted and produce fewer and smaller pods and seeds. Smaller plants may die from aphid through cell sap sucking. Aphids can destroy about 25-50% of developing plants (Kishor et al 2019)**.** The cultivation of resistant genotypes is considered as simple, easy, cheap and ideal method of combating pest problem without causing any hazards to environment and development of resistance in insect pest. From farmer's point of view, this can be a most acceptable form of pest control technique. Selection of resistant genotypes may be helpful in reducing pest damage. Therefore, the present study was designed to screen different genotypes of lentil against the infestation of *Aphis craccivora* Koch in inner Tarai of Nepal. The present study was undertaken in order to find out the tolerant lentil genotypes among different traits and the direct and indirect contributions of these traits toward yield.

MATERIALS AND METHODS

Twenty lentil genotypes received from Grain Legumes Research Program, Khajura, Banke were screened for relative tolerance against aphid at the research field of National Maize Research Program (NMRP), Rampur, Chitwan during winter seasons of two consecutive years 2016 and 2017. The geographical location of NMRP, Rampur, Chitwan is in 27˚40' N latitude, 84˚19' E longitude at an altitude of 228 meter above sea level. It has humid and subtropical climate with cool winter and hot summer. The soil is generally acidic (pH 4.6-5.7), light textured and sandy loam. The average total annual rainfall was 2215.30 mm with a distinct monsoon period (>75% of annual rainfall) from mid-June to mid-September. The design of the experiment was Randomized Complete Block having three replications. The unit plot size was 4m × 1 m with 25cm row to row spacing and continues plant to plant spacing was maintained and net harvested plot was 4 square meters. The recommended dose of fertilizer was 20:40:20 $N:P_2O_5:K_2O$ kg/ha and seed rate 30 kg/ha. Insect data were collected based on aphid population found at apical twigs (10 cm) per plant and aphid scoring during flowering and pod formation stage. From each entry, randomly ten plants were selected and recorded the observations. The assessment of infestation by insect pests on various crops was done as per the scale given by Nagrare and his co-workers (Nagrare et al 2011). The grain yield was recorded. All data were analyzed statistically using MSTAT-C computer package program. The treatment means were compared by the Least Significant Difference (LSD) test at 5% level (Gomez and Gomez 1984, Shrestha, 2019). The aphid population data were subjected to square root transformation before statistical analysis.

RESULTS

The results revealed that all the lentil genotypes differed significantly in respect the aphid population per plant apical twigs (10 cm) during flowering and pod formation stage at NMRP, Rampur in 2016 winter season. Among the genotypes, ILL 6458 (2 aphid /plant) was recorded as the least susceptible genotype followed by Sagun (2 aphid /plant), ILL-10856 (3 aphid /plant), RL-83 (4 aphid /plant), ILL-9924 (5 aphid /plant) and RL-67 (6 aphid /plant) respectively (**Table** 1). Statistically highly significant differences were observed in grain yield of different lentil genotypes. The higher grain yield was found in genotype ILL 9924 (1727 kg/ha), followed by RL-83 (1632 kg/ha) and ILL 10856 (1570 kg/ha) (**Table** 1).

Table 1. Response of different lentil genotypes against the aphid infestation and grain yield at NMRP, Rampur during 2016 winter

Genotypes	Aphid / plant apical twigs (10 cm)		Mean aphid population/plant	Aphid Scoring (1-4)	Grain Yield (kg/ha)
	During flowering	During pod formation			
RL-68	†29 (5.43)	59 (7.71)	44 (6.67)	3	1129
RL-67	0 (0.71)	11 (3.43)	6 (2.48)	1	1505
RL-71	0 (0.71)	21 (4.64)	11 (3.31)	1	1435
RL-45	0 (0.71)	24 (4.91)	12 (3.51)	1	1410
RL-83	0 (0.71)	7 (2.74)	4 (1.99)	1	1632
RL-28	20 (4.53)	50 (7.11)	35 (5.96)	3	1197
ILL-6458	0 (0.71)	3 (1.81)	2 (1.38)	1	1535
ILL-9924	0 (0.71)	10 (3.24)	5 (2.35)	1	1727
NR2001-71-3	25 (5.05)	55 (7.45)	40 (6.36)	3	1170
RL-44	36 (6.04)	66 (8.15)	51 (7.18)	3	1070
ILL-10068	0 (0.71)	15 (3.94)	8 (2.83)	2	1440
ILL-10853	8 (2.91)	38 (6.20)	23 (4.85)	2	1294
ILL-2437	17 (4.18)	47 (6.89)	32 (5.70)	2	1252
ILL-10045	14 (3.76)	44 (6.65)	29 (5.40)	2	1259
ILL-10065	38 (6.20)	68 (8.28)	53 (7.31)	3	962
RL-60	33 (5.82)	63 (7.99)	48 (6.99)	3	1087
ILL-8010	31 (5.61)	61 (7.84)	46 (6.82)	3	1099
ILL-10856	0 (0.71)	5 (2.34)	3 (1.73)	1	1570
RL-55	0.7 (1.0)	30 (5.52)	15 (3.98)	2	1339
Sagun	0 (0.71)	4 (2.04)	2 (1.52)	1	1510
P value	0.000	0.000	0.000	0.000	0.000
LSD (0.05)	0.22	0.32	0.23	0.38	118.7
CV,%	4.64	3.57	3.18	11.77	5.39

† Means of 3 replications, RL- Rampur Lentil, ILL- ICARDA Lentil Line, cm- centimeter, kg/ha- kilogram per hectare

During 2017 winter, all the screened lentil genotypes differed significantly with aphid population per plant apical twigs (10 cm) during flowering and pod formation stage at NMRP, Rampur. Among the genotypes, ILL 9924 (2 aphid /plant) was recorded as the least susceptible genotype followed by RL-83 (3 aphid /plant), ILL-10856 (4 aphid /plant), ILL 6458 (6 aphid /plant) and Sagun (8 aphid /plant) respectively (**Table** 2).

Table 2. Evaluation of lentil genotypes against the aphid infestation and grain yield at NMRP, Rampur during 2017 winter

Genotypes	Aphid /plant apical twigs (10 cm)		Mean aphid population/ plant	Aphid Scoring (1-4)	Grain Yield (kg/ha)
	During flowering	During pod formation			
RL-68	†46 (6.82)	72 (8.51)	59 (7.67)	3	1087
RL-67	0 (0.71)	24 (4.98)	12 (2.93)	1	1463
RL-71	8 (2.90)	34 (5.87)	21 (4.39)	2	1393
RL-45	11 (3.34)	37 (6.09)	24 (4.72)	2	1368
RL-83	0 (0.71)	6 (2.55)	3 (1.63)	1	1590
RL-28	37 (6.12)	63 (7.97)	50 (7.05)	3	1155
ILL-6458	0 (0.71)	12 (3.53)	6 (2.12)	1	1493
ILL-9924	0 (0.71)	3 (1.86)	2 (1.28)	1	1685
NR2001-71-3	42 (6.52)	68 (8.28)	55 (7.40)	3	1128
RL-44	53 (7.31)	79 (8.92)	66 (8.12)	4	1028
ILL-10068	2 (1.56)	28 (5.34)	15 (3.45)	2	1398
ILL-10853	25 (5.05)	51 (7.18)	38 (6.11)	3	1252
ILL-2437	34 (5.87)	60 (7.78)	47 (6.83)	3	1210
ILL-10045	30 (5.58)	57 (7.56)	44 (6.57)	3	1217
ILL-10065	55 (7.45)	81 (9.03)	68 (8.24)	4	920
RL-60	50 (7.13)	76 (8.77)	63 (7.95)	4	1045
ILL-8010	48 (6.96)	74 (8.63)	61 (7.80)	3	1057
ILL-10856	0 (0.71)	8 (2.91)	4 (1.81)	1	1528
RL-55	17 (4.18)	43 (6.60)	30 (5.39)	1	1297
Sagun	0 (0.71)	16 (4.06)	8 (2.38)	2	1468
P value	0.000	0.000	0.000	0.000	0.000
LSD (0.05)	0.24	0.18	0.18	0.38	115.70
CV,%	3.57	1.74	2.12	9.75	4.57

† Means of 3 replications, RL- Rampur Lentil, ILL- ICARDA Lentil Line, cm- centimeter, kg/ha- kilogram per hectare

The higher grain yield (**Table** 2) was found in genotypes ILL 9924 (1685 kg/ha), followed by RL-83 (1590 kg/ha) and ILL 10856 (1528 kg/ha) and ILL 6458 (1493 kg/ha).

Relationship between grain yield and aphid population

The predicted linear regression line was displayed downward slope, ie Y = -9.584x + 1585, with regression coefficient R^2 = 0.95, where 'Y' denoted predicted grain yield of crop and 'x' stood for mean aphid population per plant. The estimated regression line indicated that the unit rise in the aphid population, there existed possibilities of grain yield reduction by 9.584 kg/ha (**Figure** 1).

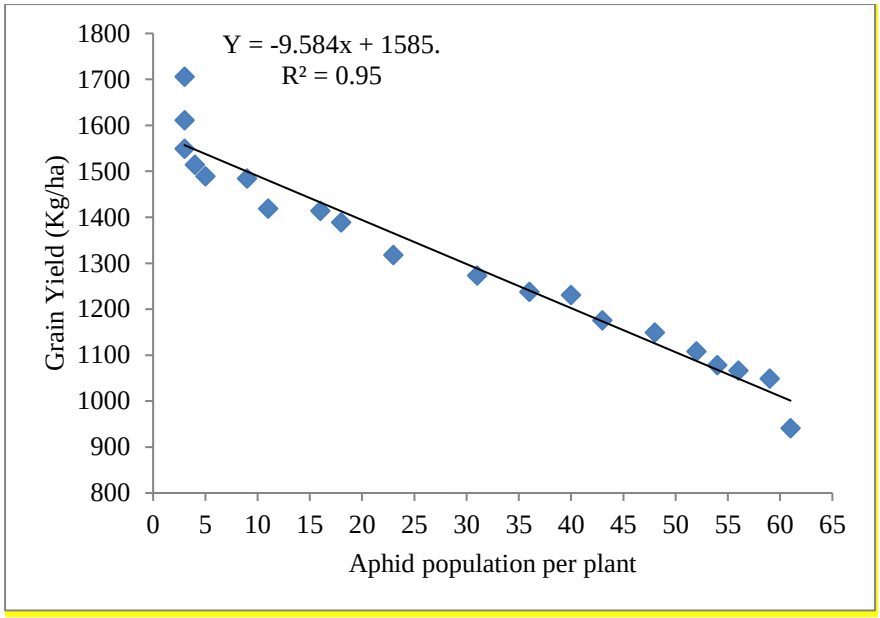

Figure 1. Relationship between grain yield and mean aphid population per plant during winter season 2017 at NMRP, Rampur, Nepal.

DISCUSSION

The mechanism of host plant resistance in response to insect infestation consists of a series of biochemical events, including increased production of phenolics, mediated by phenylalanine ammonia-lyase, tyrosine ammonialyase, peroxidase and polyphenol oxidase (Divya et al 2017). The primary metabolites include carbohydrates and proteins, which are exploited by the herbivores for their growth and development and also function as precursors of secondary substances, which are major elements of resistance in plants (Edreva et al 2008). The present finding was supported by the reports of the Kishor et al (2019) who screened one hundred and twelve accessions of lentil for tolerance to black aphids and some morphological attributes were recorded to find the association with aphid incidence. Low infestation of aphids was observed on genotypes with green or yellowish green foliage and slightly pubescent leaves and yield attributes were recorded to find the association with aphid incidence (Kumari et al 2009). Moderate infestation was recorded in genotypes with dark green foliage while genotypes with ash green foliage and densely pubescent leaves were highly susceptible to aphids (Morales and Bleicher 2007).

CONCLUSION

Grain yield had strong negative correlation with the aphid population. Lentil genotypes ILL 9924, RL 83, ILL 10856, ILL 6458 and RL 67 were less susceptible to aphid infestation and resulted in higher grain yield. The study can be useful for selecting suitable lentil genotypes for the development of aphid tolerant high yielding lentil variety in inner Tarai of Nepal.

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