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Performance of Promising Potato Genotypes in Red Ant (*Dorylus orientalis*) Management

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This experiment was carried out to identify appropriate potato genotypes for red ant management and increase the tuber yield of potato during 2020 and 2021 years. Eight different promising potato genotypes [1. PRP-056267.9 2. PRP-85861.11 3. CIP-394311.112 4. PRP-136368.1 5. PRP-22627.1 6. PRP-296668.1 7. Janakdev (standard check) and 8. Ilam local (Bite)] received from National Potato Research Program (NPRP), Khumaltar, Lalitpur, Nepal were included in the study. Experiment was conducted in previously red ant infected potato field in Completely Randomized Block Design with three replications. The experimental plot size was 5.4 m^2 (3m x 1.8m) where planting tubers was done at 60 cm row to row and 25 cm plants to plant spacing. Fertilizers of NPK were applied at the rate of 100:100:60 kg /ha and 20 t/ha compost. Well sprouted tubers with weight 30-40 g were planted during the second week of February. Harvesting was done during the last week of July. Data on yield attributing traits, late blight disease, and number of red ant damaged tubers, red ant infested yield and healthy tuber yield were recorded. The standard check

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potato variety Janakdev (1.00 red ant score, 2.32 – 2.36 % red ant incidence percentage and 0.66 – 0. 71 t/ha red ant infected tuber yield), PRP-056267.9 (1.00 red ant score, 4.51 – 5.10 % red ant incidence percentage and 0.56 – 0. 67 t/ha red ant infected tuber yield) and PRP-85861.11 (1.00 red ant score, 4.55 – 5.47 % red ant incidence percentage and 0.76 – 0. 86 t/ha red ant infected tuber yield) were found tolerant to red ant infestation and produced the highest tuber yield (27.74 t/ha – 28.62 t /ha by Janakdev variety followed by 21.79 - 22.26 t/ha by PRP-056267.9 and 21.09 - 21.05 t/ha by PRP-85861.11 potato genotypes). Therefore, planting of Janakdev variety as well as PRP-056267.9 and PRP-85861.11 potato genotypes is appropriate for higher potato tuber yield and lower down red ant incidence at Jaubari area.

Keywords: Potato; genotypes; red ant; incidence; tuber yield; infested yield.

1. INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important and predominant tuber crop in Nepal, and occupies fifth position in terms of area coverage and 2nd place in production as well as 1st position in productivity [1]. Potato is one of the most important vegetable crops in plains and lower hills while it is a staple food in high hills and mountains of Nepal. It is cultivated as winter crop in tropical and subtropical region and as summer crops in the temperate region of Nepal. It is one of the rare non-cereal foods that meet the nutritional requirement of the fast growing population particularly in the developing country like Nepal [2]. It has significant role in the income generation, food production and overall poverty alleviation as it has a high cash value and short cropping duration. Potato plays an important role in food security and livelihood due to its high cash, food and nutritive value [3].

In the year 2021/22 area under potato in Nepal was reported 198,788 ha and total production 33,25,231 ton with an average productivity of 16.73 t/ha [4] which is lower than its potentiality (about 30 mt/ha of released varieties) due to many biotic and abiotic factors [5]. Several production factors are responsible for reduction of production and productivity of potato could be due to loss of valuable local genotypes; lack of improved cultivation practices; weed infestation causing potato crop loss up to 80% [6], inadequate supply of quality seed; occurrence of pest (red ants, potato tuber moth and White grub) and disease especially late blight causes great damage in developing countries and low soil and nutrient management practices. Apart from other factors red ants (*Dorylus orientalis*) have been playing a significant role and have become serious to manage with some of the common chemicals and even with a single control method.

Agriculture Research Station (ARS), Jaubari is located at an altitude of 2900 masl where potato were planted during February – March. Farmers in Jaubari used the local potato genotypes susceptible to insect pests and diseases problems with low production potentialities. Where red ant insect pest is major yield reducing biotic factors [5]. In past, several hazardous chemicals pesticides were recommended for red ant management without considering its side effect to human beings and other living creatures. Since the government organizations have been playing a significant role in creating awareness against pesticides, present situation in Nepal is favorable for the initiation of traditional methods and practices for insect pest management. While, the use of the resistance/tolerant potato varieties is more stable, sustainable and cost-effective from the technical, ecological, economic and environmental view point. So, this study and works has been proposed to find out and disseminate resistance/tolerant potato varieties against potato pests. This could be a very useful tool for the research and extension for enhancing economic return of the high hills community in the future.

2. MATERIALS AND METHODS

These experiments were conducted at Agricultural Research Station (ARS), Jaubari, Illam (27.0331^0 north, 88.0403^0 east and 2900 masl), Nepal during 2020 and 2021 to identify the appropriate potato genotypes for red ant management and the tuber yield of potato at the high hill of Ilam district. Eight different promising potato genotypes [1. PRP-056267.9 2. PRP-85861.11 3. CIP-394311.112 4. PRP-136368.1 5. PRP-22627.1 6. PRP-296668.1 7. Janakdev (standard check) and 8. Ilam local (Bite)] received from National Potato Research Program (NPRP), Khumaltar, Lalitpur, Nepal were included in the study. Experiments were

conducted in previously red ant infected potato field in Completely Randomized Block Design (RCBD) with three replications. The experimental plot size was 5.4 m^2 (3m x 1.8m) with 60 cm row to row and 25 cm plants to plant spacing accommodating 30 seed potato tubers per plot. The plots were fertilized with 100:100:60 kg NPK/ha and 20 t/ha compost. Well sprouted tubers size of 30-40 g were planted during the second week of February. The cultural operations were carried out as per the recommendation of National Potato Research Program (NPRP). Harvesting was done during the fourth week of July. Data taken were days to 50% emergence, ground coverage (%), number of main stem/plants, number of tubers per plant, red ant damage scoring (1-5 scale) [1], red ant incidence (%), red ant infested yield (kg/plot), number of tubers/plant and total yield (kg/plot). Ground coverage was measure 100% when all the plants covers almost all the ground, then based on the canopy of plant to cover the ground percentage was estimated. Plant uniformity was observed in 1-5 scale [1], where 5 was given to almost uniform plants. Late blight scoring was done in 1-9 scale where 1 was given for no infection of disease (resistant) and 9 was given when the disease was observed up to stems i.e. highly susceptible. Similarly damaged of ant was measured as 1-5 scoring scale as; 1=No infestation to 5= severe infestation. The percentage of insects damaged potato tuber was calculated as follows:

$$Red\ ant\ incidence\ \% = \frac{No.of\ red\ ant\ infected\ tuber}{Total\ No\ of\ tuber} \times 100$$

2.1 Data Analysis

The collected data were entered on MS-excel and data analysis was done using GEN-STAT software and mean separation was done by LSD at 5% level of significance.

3. RESULTS

3.1 Yield Attributing Traits

The performance of promising potato genotypes on yield attributing traits is presented in Table 1. Most of the observed parameters were found non-significant whereas main stem per plant was found significant in 2020. Days to 50% emergence ranges from minimum 58.00 days in genotype PRP-296668.1 to maximum 70.00 days in genotype CIP-394311.112 during 2020 and in 2021 it varies from minimum 65.00 days in same genotype PRP-296668.1 to maximum 69.00 days in genotype PRP-85861.11. The results indicate that potato genotype PRP-296668.1 takes short duration (58.00 – 65.00 days to 50 % emergence). Ground coverage and number of main stems per plant plays significant roles for the tuber yield of potato. Maximum ground coverage percentage (80.00 %) were observed from the genotypes PRP-056267.9, PRP-85861.11 and Janakdev in year 2020 where as it was maximum (83.00 %) in the genotype Janakdev during 2021. Number of main stems per plant was significantly highest (5.00) in the genotype Janakdev during 2020. However same genotype produced maximum (4.00) number of main stem per plant in 2021.

3.2 Plant Uniformity, Plant Height and Late Blight Scoring

The performance of promising potato genotypes on vegetative parameters such as plant uniformity and plant height as well as late blight scoring is presented in Table 2. Plant uniformity (1-5 scale) of the tested potato genotypes in both the experimental year was found statistically at par with each other. It ranged from 1.30 to 3.00 scoring scale in 2020 and 2.30 to 3.00 scoring scale in 2021. Plant height of the tested potato genotypes significantly varies from shortest 29.10 cm to tallest 55.20 during 2020. The standard check potato variety Janakdev found tallest (55.20 cm) followed by PRP-296668.1 (54.00 cm), PRP-136368.1 (52.80 cm) and PRP-22627.1.In 2021 it varies from shortest 25.00 cm in genotype CIP-394311.112 to tallest 40.80 cm in Janakdev variety. Effect of potato genotypes were found highly significant (p=0.01) to late blight disease outbreak. The standard check potato variety Janakdev was found resistance (1 scoring scale in 1 -9 scale) to late blight disease in both the experimental year. The Ilam local potato genotype (Bite) was found more (2.33 scoring scale in 2020 and 3.00 scoring scale in 2021 in 1 -9 scale) prone to late blight disease. Other resistance (1 scoring scale in 1 -9 scale) genotypes were PRP-056267.9, PRP-85861.11 and PRP-136368.1 in both the year.

3.3 Red Ant Damaged and Infested Yield

The performance of promising potato genotypes on red ant scoring, incidence and infested yield of potato is presented in Table 3. The genotypes

had significant effects on the red ant occurrence on 2020. The standard check potato genotype Janakdev had the lowest red ant score (1.0) scale, red ant incidence (2.36%) and less infected tuber yield (0.66 t/ha) respectively whereas the Ilam local (Bite) potato genotype had the highest red ant infestation score (2.33), red ant incidence (13.68%) and the highest (3.69 t/ha) infested tuber yield.

Similarly, the potato genotypes had significant effects on the red ant occurrence on 2021. The standard check potato genotype Janakdev had the lowest red ant score (1.0) scale, red ant incidence (2.32%) and less infested tuber yield (0.71 t/ha) respectively whereas Ilam local (Bite) potato genotype had the highest red score (1.67), red ant incidence (9.43%) and the highest (2.23 t/ha) infected tuber yield.

3.4 Tuber Number and Tuber Yield

The tuber number and tuber yield of tested promising potato genotypes is presented in Table 4. The numbers of tubers of tested potato genotypes were found similar in all genotypes where as significant difference was recorded in tuber yield per hectare among the potato genotypes tested. Tuber number per plant varies from 6.00 to 9.00 in both the experimental year.

Table 1. Performance of promising potato genotypes on yield attributing traits of potato at ARS, Jaubari during 2020 and 2021

Treatments	Days to 50% emergence		Ground coverage (%)		Main stem number / plant	
	2020	2021	2020	2021	2020	2021
PRP-056267.9	63.00	67.00	80.00	60.00	4.00	3.00
PRP-85861.11	63.00	69.00	80.00	80.00	4.00	3.00
CIP-394311.112	70.00	67.00	70.00	79.30	3.00	3.00
PRP-136368.1	64.00	66.00	78.30	80.00	4.00	3.00
PRP-22627.1	63.00	68.00	73.30	75.00	3.00	3.00
PRP-296668.1	58.00	65.00	75.00	80.00	3.00	3.00
Janakdev (standard check)	62.00	67.00	80.00	83.30	5.00	4.00
Ilam local (Bite)	60.00	68.00	68.30	58.00	3.00	3.00
GM	63.00		75.60	74.50	3.62	3.12
F-test	NS	NS	NS	NS	*	NS
LSD 0.05	-	-	-	-	1.15	-
CV%	12.00	33.30	7.30	25.30	17.70	15.60

*GM-Grand mean; NS – Non significant; * – Significant; **– Highly significant*

Table 2. Performance of promising potato genotypes on plant uniformity, plant height and late blight scoring at ARS, Jaubari during 2020 and 2021

Genotypes	Plant uniformity (1-5 scale)		Plant height (cm)		Late blight scoring (1-9 scale)	
	2020	2021	2020	2021	2020	2021
PRP-056267.9	1.60	2.30	34.70	28.90	1.00	1.00
PRP-85861.11	2.00	2.30	39.50	28.60	1.00	1.00
CIP-394311.112	2.60	2.60	34.50	25.00	1.00	2.60
PRP-136368.1	2.00	2.30	52.80	33.80	1.00	1.00
PRP-22627.1	2.30	3.00	52.00	27.70	1.00	2.60
PRP-296668.1	2.60	2.60	54.00	34.80	1.00	2.30
Janakdev (standard check)	3.00	2.60	55.20	40.80	1.00	1.00
Ilam local (Bite)	1.30	2.30	29.10	27.60	2.33	3.00
GM	2.08	2.50	44.00	30.90	1.16	1.80
F-test	NS	NS	*	NS	**	**
LSD	-	-	12.39	-	0.89	1.03
CV (%)	33.30	26.50	16.10	20.60	122.80	44.40

*GM-grand mean; *– Significant; **– Highly significant*

Table 3. Performance of promising potato genotypes on red ant damage, incidence and infested yield of potato at ARS, Jaubari during 2020 and 2021

Genotypes	Red ant scoring (1-5) scale		Red ant incidence %		Red ant infested yield (t/ha)	
	2020	2021	2020	2021	2020	2021
PRP-056267.9	1.00	1.00	4.51	5.10	0.56	0.67
PRP-85861.11	1.00	1.00	4.55	5.47	0.76	0.86
CIP-394311.112	1.33	1.00	8.46	9.02	0.99	1.18
PRP-136368.1	1.00	1.00	4.65	5.19	0.81	0.71
PRP-22627.1	1.66	1.33	10.45	8.44	2.00	2.04
PRP-296668.1	2.00	1.00	8.48	5.75	1.71	1.72
Janakdev (standard check)	1.00	1.00	2.36	2.32	0.66	0.71
Ilam local (Bite)	2.33	1.67	13.68	9.43	3.69	2.23
GM	1.41	1.12	7.14	6.34	1.39	1.26
F-test	**	*	**	**	**	**
LSD	0.89	0.50	2.35	2.16	0.49	0.58
CV (%)	20.50	34.00	39.21	38.70	34.0	46.21

*GM-grand mean; *– Significant; **– Highly significant*

Table 4. Performance of promising potato genotypes on yield of potato at ARS, Jaubari during 2020 and 2021

Genotypes	Tubers number /plant		Tuber yield (t/ha)	
	2020	2021	2020	2021
PRP-056267.9	9.00	8.00	22.26	21.79
PRP-85861.11	7.00	9.00	21.05	21.09
CIP-394311.112	7.00	8.00	17.11	20.70
PRP-136368.1	8.00	7.00	19.12	19.48
PRP-22627.1	7.00	6.00	17.56	17.04
PRP-296668.1	8.00	7.00	17.38	18.40
Janakdev (standard check)	8.00	9.00	28.62	27.74
Ilam local (Bite)	6.00	7.00	14.99	16.74
GM	7.50	7.62	19.81	20.37
F-test	NS	NS	**	**
LSD 0.05	-	-	5.29	3.80
CV%	34.58	43.80	16.21	14.78

*GM- Grand mean; NS – Non significant; * – Significant*

Significantly, maximum tuber yield (28.62 t/ha and 27.74 t/ha, respectively in 2020 and 2021) was recorded in standard check Janakdev potato variety that was followed by PRP-056267.9 (22.26 t/ha and 21.79 t/ha, respectively in 2020 and 2021) and PRP-85861.11 (21.05 t/ha and 21.09 t/ha, respectively in 2020 and 2021). Significantly lower yield was found in Ilam local genotype in both the year. It was observed as 14.99 t/ha and 16.74 t/ha respectively in 2020 and 2021.

4. DISCUSSION

This study revealed that vegetative parameters: days to 50% emergence, ground coverage %, main stem number per plant, plant uniformity (1-5 scale) as well as tuber number per plant were found statistically non-significant with each other. Plant height (cm) was found significant in the First season, while in the second season it was found non-significant in 2021. Red ant damaged, infested yield and tuber yield per hectar were found highly significant. The significant variation in vegetative as well as yield parameters has been reported by different researchers [7,8,9]. Significant differences for almost all the vegetative as well as yield parameters show the wider genetic diversity as well as variability and potentiality among the tested potato genotypes [10,11]. Variation in plant uniformity (50-90%), ground coverage (50 -95%), late blight score (1 – 8 scale in 1-9 scoring scale), red ant incidence (2 – 20%) and tuber yield (9.47 – 32.80 t/ha) were found among 84 potato genotypes tested in Agriculture Research Station, Jaubari, Ilam [12].

Damage of red ant was associated with the tuber quality and tenderness of the potato genotypes. The standard check potato variety Janakdev had the lowest red ant score (1.00 scale), red ant incidence (2.32 - 2.36 %) and less red ant infected tuber yield (0.66 – 0.71 t/ha), respectively followed by PRP-056267.9 [1.00 red ant score, 4.51 – 5.10 % red ant incidence percentage and 0.56 – 0. 67 t/ha red ant infected tuber yield] and PRP-85861.11 [1.00 red ant score, 4.55 – 5.47 % red ant incidence percentage and 0.76 – 0. 86 t/ha red ant infected tuber yield]. The total yield is associated with size of the tubers and the losses caused by diseases and insect pests. Significantly, maximum tuber yield (27.74 t/ha – 28.62 t /ha) was found in standard check Janakdev variety that was followed by PRP-056267.9 (21.79 - 22.26 t/ha) and PRP-85861.11 (21.09 - 21.05 t/ha). This indicates that these genotypes were found better from the red ant management and tuber yield point of view in high hill of Ilam district of Nepal.

5. CONCLUSION

Based on the results in this study it is concluded that the performance of potato genotypes had influencing role on the yield attributing traits, insect pest occurrences and tuber yield of potato. Potato genotypes significantly affected the plant height, late blight damaged, red ant occurrence and damaged as well as the potato tuber yield. The standard check potato variety Janakdev (1.00 red ant score, 2.32 – 2.36 % red ant incidence percentage and 0.66 – 0. 71 t/ha red ant infected tuber yield), PRP-056267.9 (1.00 red ant score, 4.51 – 5.10 % red ant incidence percentage and 0.56 – 0. 67 t/ha red ant infected tuber yield) and PRP-85861.11 (1.00 red ant score, 4.55 – 5.47 % red ant incidence percentage and 0.76 – 0. 86 t/ha red ant infected tuber yield) were found tolerant to red ant infestation and produced the highest tuber yield (27.74 t/ha – 28.62 t /ha by Janakdev variety followed by 21.79 - 22.26 t/ha by PRP-056267.9 and 21.09 - 21.05 t/ha by PRP-85861.11 potato genotypes). Therefore, planting of Janakdev variety as well as PRP-056267.9 and PRP-85861.11 potato genotypes is appropriate for higher potato tuber yield and lower red ant incidence at Jaubari area.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. NPRP. Annual technical report. National Potato Research Program (NPRP), Khumaltar, Lalitpur, Nepal; 2018.
2. CIP. Potato in the year 1990. Situation and prospects of the world potato economy. International Potato Center (CIP) and Food and Agriculture Organization (FAO) of United Nation, Rome. 1995;39.
3. Gautam IP, Sharma MD, Khatri BB, Thapa RB, Shrestha K, Chaudhary D. Effect of nitrogen and potassium on yield, storability and postharvest processing of potato for chips.Nepal Agric. J. Vol. 2011; 11:40-51.
4. ABPSD (Agri-Business Promotion and Statistics Division). Statistical information on Nepalese Agriculture 2021/22. Government of Nepal. Ministry of Agricultural Development. Agri-Business Promotion and Statistics Division, Statistics Section, Singha Durbar, Kathmandu, Nepal; 2022.
5. ARS. Annual Report. Agricultural Research Station (ARS), Jaubari, Ilam, Nepal; 2019.
6. Ghimire J, Chaudhary D. Integrated weed management study on potato at Hattiban Khumaltar, Lalitpur. In: Proceedings of the National Potato Working Group (NPWG, March 14-15, 2010. National Potato Research Programme, Khumaltar, Lalitpur, Nepal; 2010.
7. Khanal A, Rijal A, Timilsina S, Adhikari RC, Upadhyay KP, Pun TB. Selection of Suitable Potato Genotypes in Western High Hills of Nepal. Proceeding of Ninth National Horticulture Workshop, May 31 to June 1, 2017. NARC, HRD, Khumaltar, Lalitpur, Nepal. 2017;203-208.
8. Pant S, Pariyar K, Chaudhary JN, Giri P, Sapkota P, Dev ML, Upadhyay KP, Pandey S. Performance Evaluation of Different Potato Genotypes Under Dailekh Conditions. Proceeding of Ninth National Horticulture Workshop,May 31 to June 1,

2017.NARC,HRD, Khumaltar, Lalitpur, Nepal. 2017;209-213.

9. Upadhyay K P, Pandey S, Khatri BB, Luitel B, Tripathi N, Poudel K, Timilsina C, Piya S, Gautam S. Variation of Yield and Yield Attributing Parameters of Promising Clones of Potato. Proceeding of Ninth National Horticulture Workshop, May 31 to June 1, 2017. NARC, HRD, Khumaltar, Lalitpur, Nepal. 2017;195-202.
10. Chapagain TR, Tiwari DN, Adhikaari RC, Khatri BB, Luitel B. Performance of Potato Clones in Mid Hill of Western Nepal. Proceedings of National Potato Research Workshop, March 31 to April 2, 2014. NARC, NPRP, Khumaltar, Lalitpur, Nepal. 2014;11-16.
11. Giri RK, Bhusal YR, Gautam S, Paneru PB, Subedi GD, Khadka K, Lama L, Khatri BB, Luitel BP, Regmi H, Khadka D, Khathyat DB, Budha C. Performance of Micronutrient Dense Potato Genotypes. The Journal of Agriculture and Environment. 2016;17:118-123.
12. ARS. Annual Report. Agricultural Research Station (ARS), Jaubari, Ilam, Nepal; 2017.

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