

RESPONSE OF POTATO (*Solanum tuberosum* L.) GENOTYPES TO DIFFERENT MOISTURE CONDITIONS IN MID-WESTERN TERAI OF NEPAL

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ABSTRACT

The experiment was carried out during the winter season of two consecutive years (2013/14 and 2014/15) at Regional Agriculture Research Station (RARS), Khajura, Banke in Mid-Western Development Region of Nepal. Experiment was laid out in a split-plot design with three replications. Main-plot consisted of three moisture conditions namely Irrigated, Mulched and Rain-fed, whereas sub-plot had eight potato genotypes namely LBr-40, NPI-106, CIP388676.1, CIP396011.47, CIP395192.1, Cardinal, Desiree and Tharu Local. The two years mean data were considered. Significantly the highest emergence percent (97.1%) was obtained from Irrigated condition and the lowest emergence (84.3%) from Rain-fed condition. Significantly the highest emergence percent (95.5%) was obtained from the genotype Cardinal followed by NPI-106 (94.6%), CIP388676.1 (94.4%) and Tharu Local (90.6%) which were at par. The lowest late blight severity score (4.0) was from Mulched condition and the highest score (4.7) was from Irrigated condition. Significantly the lowest late blight severity score (1.0) was from the genotypes LBr-40, whereas the highest score (5.3) was from the genotype CIP395192.1. Significantly the highest yield (17.6 t ha⁻¹) was from Irrigated condition followed by Mulched condition (15.7 t ha⁻¹) whereas the minimum yield (10.7 t ha⁻¹) was from Rain-fed condition. Significantly the maximum yield (23.2 t ha⁻¹) was from the genotype CIP388676.1 and the minimum yield (3.7 t ha⁻¹) was from Tharu Local. Keeping in view the yield parameters and late blight resistance the genotypes CIP 388676.1 and LBr-40 were found superior to other genotypes under the Irrigated, Mulched and Rain-fed conditions. However among the three moisture conditions Irrigated and Mulched conditions were superior to Rain-fed condition for potato cultivation in the mid-western terai of Nepal.

Key words: Genotypes, potato, moisture conditions, late blight severity, resistance.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important food crops of the world. The annual world production of potato is about 364.81 million tons over an area of about 19.24 million hectares with the productivity of about 19.44 t ha⁻¹ of which nearly one third is produced in China and India (FAOSTAT, 2014). The crop stands at fifth position in terms of area of cultivation after rice, maize, wheat and millet, 2nd in total production, and 1st in productivity. The area under potato at present in Nepal is about 2,05,725 ha, production 28,17,512 tons with an average productivity of 13.696 t/ha and its contribution to AGDP is 10% and GDP is 3.25% (MoAD, 2014). Mid and Far-western terai is one of the largest areas (16,455 ha) for potato production in the country but yields are comparatively low (NPRP, 2015). Lack of irrigation is one of the major contributing factors for lower productivity and the potato varieties cultivated are not drought tolerant. Keeping the above facts in view the present investigation entitled “Response of potato (*Solanum tuberosum* L.) genotypes to different moisture conditions in mid-western terai of Nepal” was designed and carried out with the objectives of selecting suitable potato genotypes for Irrigated, Mulched and Rain-fed conditions as well as suitable moisture conditions.

MATERIALS AND METHODS

The experiment was conducted during the winter season of two consecutive years (2013/14 and 2014/15) at RARS, Khajura, Banke district, Nepal. Experiment was laid out in a split-plot design with three replications. Main-plots consisted of three moisture conditions namely Irrigated, Mulched and Rain-fed, whereas sub-plots had eight potato genotypes namely LBr-40, NPI-106, CIP388676.1, CIP396011.47, CIP395192.1, Cardinal, Desiree and Tharu Local. The size of an individual plot was 5.4 m² (3 m × 1.8 m). The plant to plant and row to row spacing was maintained at 0.25 m. x 0.60 m. accommodating 36 plants in each plot. Fertilizers were applied @100:100:60

kg ha⁻¹ (N: P2O5:K2O) and 20 t ha⁻¹ compost as a basal dose. Full doses of compost, nitrogen, phosphorus and potassium were applied at planting as a basal dose. The data were statistically analyzed using GENSTAT software. Means were separated by LSD and DMRT of MSTAT-C.

RESULTS AND DISCUSSION

Data on the emergence percent, late blight severity and yield of potato were recorded in both the years and their mean values have been presented in Table 1.

Effects of moisture conditions and genotypes on emergence percent

In the 1st year (2013/14), significantly maximum emergence percent (99.2%) was obtained from Irrigated condition followed by Mulched condition (92.7%), both being at par, whereas the minimum emergence (83.4%) was from Rain-fed condition. In the 2nd year (2014/15), significantly maximum emergence percent (95.0%) was obtained from Irrigated condition followed by Mulched condition (90.7%), both being at par, whereas the minimum emergence (85.2%) was from Rain-fed condition. Similarly, the mean data of both years showed significant difference. Significantly the maximum emergence percent (97.1%) was from Irrigated condition followed by Mulched condition (91.7%), both being at par, and the minimum emergence (84.3%) was from Rain-fed condition.

Several other researchers also observed similar results. The potato emergence in field condition was influenced by age and sprouting stage of tubers, soil temperature and soil moisture of the field as reported by Beukema and Van Der Zaag (1990) and Singh et al. (1993).

In the 1st year, significantly maximum emergence percent (98.1%) was obtained from the genotype Tharu Local followed by NPI-116 (97.2%), Cardinal (95.7%), CIP388676.1 (93.8%), LBr-40 (91.1%) and CIP395192.1 (90.1%) which were all at par, whereas the minimum emergence (83.9%) was from the genotype Desiree. In the 2nd year, significantly the maximum emergence percent (95.3%) was from the genotype Cardinal followed by CIP388676.1 (95.1%), CIP396011.47 (93.8%), Desiree (92.9%) and NPI-106 (92.0%) which was at par and the minimum emergence (83.0%) was from the genotype Tharu Local. Similarly, two years mean data of plant emergence showed a significant difference among the genotypes.

The maximum emergence percent (95.5%) was from the genotype Cardinal followed by NPI-106 (94.6%), CIP388676.1 (94.4%) and Tharu Local (90.6%) but they were statistically non-significant, whereas minimum emergence (87.7%) was from the genotype CIP395192.1.

The differences in emergence percent of potato genotypes might be due to their genetic character as well as soil temperature, moisture and planting time. Similar results were reported by National Potato Research Programme, Khumaltar (NPRP, 2010).

The interaction effects among moisture conditions and genotypes in the 1st year 2013/14 and both years mean did not show significant difference, whereas the 2nd year 2014/15 showed significant difference.

Effects of moisture conditions and genotypes on late blight severity

In the 1st year, the data on late blight score showed significant difference among moisture conditions. The lowest late blight severity score (2.7) was from Mulched condition followed by Rain-fed condition (3.4) and the highest score (4.1) was from Irrigated condition. In the 2nd year, however, the data showed non-significant difference. The lowest score (4.8) was from Rain-fed condition whereas the highest score (5.3) was from Mulched condition. The two years mean data showed non-significant difference on late blight score. It might be due to the continuous rain fall throughout the cropping season in the 2nd year 2014/15.

Table 1. Effects of moisture conditions and genotypes on emergence percent, late blight severity score and potato yield at RARS, Khajura, Banke, Nepal, 2013/14 and 2014/15

Treatments	Emergence (%) at 45DAP			Late blight severity score (1-9 scale)			Yield (t ha ⁻¹)		
	2013/14	2014/15	Mean	2013/14	2014/15	Mean	2013/14	2014/15	Mean
A-Moisture conditions									
Irrigated	99.2 ^a	95.0 ^a	97.1 ^a	4.1 ^a	5.2	4.7	19.6 ^a	15.7 ^b	17.6 ^a
Mulched	92.7 ^{ab}	90.7 ^{ab}	91.7 ^a	2.7 ^b	5.3	4.0	13.8 ^b	17.6 ^a	15.7 ^a
Rain-fed	83.4 ^b	85.2 ^b	84.3 ^b	3.4 ^{ab}	4.8	4.1	6.0 ^c	15.3 ^b	10.7 ^b
F- test	*	*	*	*	NS	NS	*	*	*
LSD (0.05)	13.53	8.46	8.92	0.79	-	-	4.52	1.81	2.58
CV%	6.5	4.1	4.3	10.1	12.1	10.7	15.1	4.9	7.8
B-Genotypes									
LBr-40	91.1 ^{ab}	85.2 ^b	88.1 ^c	1.1 ^c	1.0 ^d	1.1 ^c	19. ^a	20.0 ^{bc}	19.5 ^b
NPI-106	97.2 ^a	92.0 ^a	94.6 ^{ab}	4.1 ^a	5.7 ^{abc}	4.9 ^{ab}	14.1 ^{bc}	22.0 ^b	18.0 ^{bc}
CIP388676.1	93.8 ^{ab}	95.1 ^a	94.4 ^{ab}	3.1 ^b	4.8 ^c	3.9 ^d	19.5 ^a	26.9 ^a	23.2 ^a
CIP396011.47	84.2 ^b	93.8 ^a	89.0 ^{bc}	3.6 ^b	6.6 ^a	5.1 ^{ab}	13.2 ^c	17.8 ^{cd}	15.5 ^d
CIP395192.1	90.1 ^{ab}	85.2 ^b	87.7 ^c	4.3 ^a	6.2 ^a	5.3 ^a	11.1 ^{cd}	12.3 ^c	11.7 ^e
Cardinal	95.7 ^a	95.3 ^a	95.5 ^a	3.2 ^b	5.0 ^{bc}	4.1 ^{cd}	17.2 ^{ab}	16.7 ^d	17.0 ^{cd}
Desiree	83.9 ^b	92.9 ^a	88.4 ^{bc}	3.4 ^b	5.7 ^{abc}	4.6 ^{bc}	8.0 ^d	9.6 ^f	8.8 ^f
Tharu Local	98.1 ^a	83.0 ^b	90.6 ^{abc}	4.4 ^a	5.9 ^{ab}	5.2 ^a	3.2 ^e	4.2 ^g	3.7 ^g
F- test	*	**	*	**	**	**	**	**	**
LSD (0.05)	9.59	6.40	5.68	0.53	0.84	0.46	3.46	2.34	1.70
CV%	11.0	7.5	6.6	16.3	17.3	11.3	27.6	15.2	12.2
Interaction (A × B)	NS	*	NS	*	NS	NS	NS	NS	*

Means within a column followed by the same letter (s) do not differ significantly at 0.05 level of significance by DMRT

The irrigation and mulch in potato crop might be contributing to create the favorable environment of spreading the pathogens (Khatri et al., 2013).

As far as genotypes are concerned, in the 1st year, the results on late blight score showed highly significant difference among the genotypes. The Lowest late blight severity score (1.0) was from the genotype LBr-40 whereas the highest score (4.4) was from the genotype Tharu Local. Similarly, in the 2nd year, the data showed highly significant difference. Significantly the lowest score (1.0) was from the genotype LBr-40 and the highest score (6.6) was from the genotype CIP 396011.47. Similarly, the two years mean results showed highly significant difference. Significantly the lowest late blight severity score (1.0) was from the genotype LBr-40 and the highest score (5.3) was from the genotype CIP395192.1.

The interaction effect between the moisture conditions and genotypes on late blight severity score in the 1st year

2013/14 showed significant deference whereas in the 2nd year 2014/15 and in both the years' mean data it did not show significant difference.

Effects of moisture conditions and genotypes on yield

The effect of moisture conditions on yield in the 1st year 2013/14 showed significant difference. Significantly the maximum yield (19.6 t ha⁻¹) was from Irrigated condition and the minimum yield (6.0 t ha⁻¹) was from Rain-fed condition. In the 2nd year 2014/15, significantly the maximum yield (17.6 t ha⁻¹) was from Mulched condition and the minimum yield (15.3 t ha⁻¹) was from Rain fed condition. Similarly, the two years mean results showed significant difference. Significantly it was the maximum yield (17.6 t ha⁻¹) from Irrigated condition, followed by Mulched condition (15.7 t ha⁻¹) whereas the minimum yield (10.7 t ha⁻¹) was from Rain-fed condition. In the 2nd year 2014/15 during the crop growing season frequent rain fall was occurred. Due to the sufficient rain fall Mulched condition was superior than other condition. Similarly, Rain-fed condition was also better than in the 1st year 2013/14.

The effects of genotypes on yield in the 1st year 2013/14 showed highly significant difference. Significantly the maximum yield (19.5 t ha⁻¹) was from the genotype CIP388676.1 followed by LBr-40 (19.0 t ha⁻¹), Cardinal (17.2 t ha⁻¹) and the minimum yield (3.2 t ha⁻¹) was from the genotype Tharu Local. In the 2nd year 2014/15 significantly the maximum yield (26.9 t ha⁻¹) was from the genotype CIP388676.1, whereas the minimum yield (4.2 t ha⁻¹) was from the genotype Tharu Local. Similarly the both years' mean showed highly significant difference. It was the maximum yield (23.2 t ha⁻¹) from the genotype CIP388676.1 whereas the minimum yield (3.7 t ha⁻¹) was from the genotype Tharu local. It might be due to the effect of heredity of potato genotypes as well as moisture status.

The effect of interaction between moisture conditions and genotypes on yield in the 1st year 2013/14 and the 2nd year 2014/15 did not showed significant difference, whereas the both years' mean showed significant difference. In the Irrigated condition the results differed significantly, the maximum yield (26.9 t ha⁻¹) was from the genotype CIP388676.1 and the minimum yield (4.3 t ha⁻¹) was from Tharu Local. In the Mulched condition the results also differed significantly, the maximum yield (23.43 t ha⁻¹) was from the genotype CIP388676.1, whereas the minimum yield (4.5 t ha⁻¹) was from Tharu Local.

Table 2. Interaction effect between moisture conditions and genotypes on mean yield of two years at RARS, Khajura, Banke, Nepal, 2013/14 and 2014/15.

Treatments	LBr-40	NPI-106	CIP388676.1	CIP396011.47	CIP395192.1	Cardinal	Desiree	Tharu Local
Irrigated	23.0 ^{bc}	20.9 ^{bcde}	26.9 ^a	18.6 ^{def}	14.0 ^{ghi}	21.2 ^{bcd}	12.4 ^{hij}	4.3 ⁿ
Mulched	20.5 ^{bcde}	19.4 ^{bcde}	23.4 ^{ab}	17.0 ^{efg}	13.0 ^{hi}	19.5 ^{bcde}	8.6 ^{ijkl}	4.5 ^{mn}
Rain-fed	15.0 ^{gh}	13.9 ^{ghi}	19.3 ^{cde}	11.0 ^{hjk}	8.2 ^{klm}	10.2 ^{jk}	5.6 ^{lmn}	2.2 ⁿ
F-test	*							
LSD (0.05) Sub at same levels of main treatment	3.39							
LSD (0.05) Main at same levels of sub treatment	2.95							
CV%	12.2							

Means within a column followed by the same letter (s) do not differ significantly at 0.05 level of significance by DMRT

CONCLUSIONS

Keeping in view the yield parameters and late blight resistance, the genotypes CIP 388676.1 and LBr-40 were found superior to other genotypes under the Irrigated, Mulched and Rain-fed conditions. However, among the three moisture conditions, Irrigated and Mulched conditions were superior to Rain-fed condition for potato cultivation in mid-western terai of Nepal.

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