Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.13, 2015

Evaluation of Potato Germplasm for Yield under the Agro Climatic Conditions of Swat Valley

Salahuddin[1.3]*, Muhammad Sajid[2], Muhammad Razaq[1], Samiullah[2] and Farmanullah Khan[2,]

1 Northeast Forestry University, Harbin, China.
2. The University of Agriculture, Peshawar, Pakistan.
3. Agriculture Research Institute, Mingora, Swat, Pakistan.
4. Directorate of Soil and Water Conservation Khyber Pakhtunkhwa, Pakistan.

Abstract
Four cultivars and 14 clones of potato of the International Center for Potato were selected as test-germplasm to assess their yield under the agro climatic condition of Swat valley, Pakistan. The experiment was laid out in Randomized Complete Block Design with three replications and a plot size of 4.2 m^2. The genotype CIP-39007-55 recorded the highest number of stem (4.66) $plant^{-1}$, number of tubers (10.5) $plant^{-1}$, medium tuber yield (11.67 t ha^{-1}), total yield (18.68 t ha^{-1}). The genotypes CIP-393574-6 showed the highest small tuber yield (3.93 t ha^{-1}) while genotype CIP-966239-131 recorded the highest large tuber yield (6.31 t ha^{-1}). While the genotype CIP-394074-120 showed the worst results with minimum small tuber yield (0.48 t ha^{-1}), medium tuber yield (0.24 t ha^{-1}), total yield (0.73 t ha^{-1}). The least number of stems (2.33) $plant^{-1}$ were recorded in cultivar Simply Red and the lowest yield of large tuber (0.36 t ha^{-1}) were recorded in genotype CIP-3962239-111. The lowest sprouting percentage (72%) $plot^{-1}$ were recorded in cultivar Satilite while the highest sprouting percentage (100%) $plot^{-1}$ was noted in Karoda. The study showed that the genotypes CIP-39007-55, CIP-393574-6 and CIP-966239-131 are best in respect to growth and yield among the rest of potato germplasm, and are therefore recommended for cultivation in Swat valley.
Keywords: Potato, genotypes, germplasm, Swat**.**

1. INTRODUCTION

Potato (*Solanum tuberosum L.*) is herbaceous perennial plant and belongs to the Solanaceae family. Majority of the potato species originated in South and North America. Potato is cross pollinated bear red, pink, white, blue and purple flower with yellow stamins. Potato is propagated through true potato seed and potato seed. True potato seed technology is used to produce new varieties through plant breeding (Winch, 2006). Potato is a cheap source of energy because it contains a large amount of carbohydrate content. Potato also contains significant amount of vitamin B, C and minerals. Moreover it is also used in many industries for the production of starch and alcohol (Abdel *et al*., 1977).

Potato is ranged fourth most important crop after maize, rice and wheat in the world in terms of its production and occupies sixth position in yield, averaging 15.3 tons ha^{-1}. On the basis of fresh matter, it is third highest yielding crop after sugarcane and sugar beet. Potato production has increased about twenty five percent in the developing countries during the last four decades (Hijmans and Paul, 2001).

It is estimated that about 315 million tones of potato are produce in all over the world. China is now the largest potato producing country. People's Republic of China and Russia produce annually 70 and 39 million tones of potato respectively. Pakistan's annual potato production is 2 million tones that is less than 1% of the world production (Anonymous, 2009). Pakistan mainly exports potato to Sri Lanka and Afghanistan, both the markets are more convenient because, unlike Malaysia, the consumers of Sri Lanka and Afghanistan is less quality conscious.

Production-wise in Pakistan, the province of Punjab is the leading province followed by Khyber Pakhtunkhwa, Baluchistan and Sindh. The area under potato cultivation is

145 thousand hectares with a production of 2941.3 thousand tones and the national yield is 20.3 tons ha^{-1}. In Khyber Pakhtunkhwa it is grown on 9.1 thousand hectares with average yield of 13.3 tones ha^{-1} and with a total production of 129.0 thousand tones (Anonymous, 2009).

The main potato producing districts of Khyber Pakhtunkhwa are Mardan, Nowshera, Swat, Dir and Mansehra. Khyber Pakhtunkhwa is blessed with climatic and irrigation facilities that allow the grower to raise three crops during the year; spring and autumn crops are planted in the plains and summer crop in the hilly areas of Swat, Dir and Mansehra (Khan et al., 2005).

The national and provincial average yield of potato is very low due to low-yielding varieties, pest and disease attack, inadequate irrigation and fertilizer use etc. These old commercial yielding varieties used to be excellent in the start but consistent farming of these varieties has made them susceptible to the soil born diseases and pest attack. Ultimately, there is low yield and increased chances of disease infestation. The easiest method to improve the yield is to introduce and select the high yielding and disease resistant varieties.

Unfortunately there has not been enough work done on selecting best suited varieties for the agro-

climatic conditions of Swat valley and the similar climatic conditions. The present study was initiated with the aim to screen out the potato germplasm and select the high yielding variety that is suitable for cultivation in the Swat valley, Pakistan.

2. MATERIALS AND METHODS

The experiment consisted of four cultivars and 14 clones of International Center for potato. The experiment was laid out in Randomized Complete Block Design, having three replications and plot size was 4.2 m^2. Plant to Plant and Row to Row distance was kept 20 cm and 70 cm respectively. Fertilizer dose were applied at the rate of 150 N; 100 P_20_5; 100 K_20 kg ha^{-1}. Full dose of phosphorus and potash and half dose of nitrogen were applied at sowing and half dose of nitrogen was applied during earthing up. All the standard cultural practices were carried out to raise a good crop.

3. RESULTS AND DISCUSSIONS

3.1 Sprouting percentage

The mean data shows that the highest sprouting percentage (100%) $plot^{-1}$ were recorded for Karoda followed by CIP-396239-111 (99%) and CIP- 966239-131 (95.67%), while the lowest sprouting percentage (72.67%) $plot^{-1}$ and (77.33%) were recorded in cultivar Satilite and genotype CIP-396622-111.

The check cultivar Karoda and genotype CIP-396239-111 had significantly highest sprouting percentage from the rest of potato germplasm. The check cultivar Karoda showed highest sprouting percentage from the rest of potato germplasm and the lowest sprouting percentage was observed in cultivar Satilite.

Sprouting percentage is controlled by external and internal genetic factors. The environmental factor is same for all genotypes but the variation may be due to genetic variation among the genotypes. Farooq *et al.* (2002) stated that the commercial varieties have good sprouting percentage and also sprouting percentage of varieties depends upon the quality of seed potato.

3.2 Number of stem plant $^{-1}$

The mean data shows that the maximum number of stems (4.66) $plant^{-1}$ were recorded in genotype CIP-393574-6 and CIP-39007-55 (4.33), while the minimum number of stem $plant^{-1}$ were recorded in cultivar Simply Red (2.33) and Draga (2.33).

The number of stem $plant^{-1}$ in genotype CIP-393574-6 exceeded from the check cultivar Karoda. The highest number of stem $plant^{-1}$ was observed in the genotype

CIP-393574-6 that also produced maximum number of tuber $plant^{-1}$ and highest yield from the rest of potato germplasm. Difference in number of stem $plant^{-1}$ is depending upon the number of tuber eyes, maximum tuber eyes leads to maximum number of stems. The variation in number of stem among the potato germplasm is a genetic character which is the identity of each genotype. The number of stems has positive relation with the yield of tubers. Davis, (1967) and Sadique *et al.* (1987) also reported that different potato varieties produced different number of stem and tubers. The less or highest number of stem $plant^{-1}$ was the varietal character of each potato germplasm.

3.3 Number of tuber plant $^{-1}$

The mean data shows that the highest number of tubers (10.5) $plant^{-1}$ were recorded for genotype CIP-39007-55 and CIP-393574-6 (8.33), while the minimum number of tuber (0.99) $plant^{-1}$ were recorded in genotype CIP-394054-120 and CIP-393574-61 (2.49).

The potato genotype CIP-39007-55 and CIP-393574-6 had produced highest number of stem $plant^{-1}$ from the check cultivar Karoda. It may be due to the genotype

CIP-39007-55 produced the maximum number of stem leads to maximum number of tuber $plant^{-1}$. These finding are in lines with the finding of Tariq *et al.* (2008) who stated that the number of tuber $plant^{-1}$ is the main character which was closely correlated to the number of stems.

3.4 Small tuber yield (t ha^{-1})

The mean data shows that the highest small tuber yield (3.93 t ha^{-1}) was recorded in genotype CIP-966239-131, followed by CIP-39007-55 (3.57 t ha^{-1}) and CIP-393574-6 (3.57 t ha^{-1}) while the minimum small tuber yield (0.48 t ha^{-1}) was recorded in genotype CIP-394054-120 and CIP-391202-21 (0.56 t ha^{-1}).

The genotype CIP-966239-131 and CIP-39007-55 produced the maximum small tuber yield and these genotypes have also produced highest number of stem $plant^{-1}$. This shows a closed relation between the number of stem and small tuber yield. Abbas *et al.* (2006) reported that a significant variation was observed regarding small tuber yield and showed a close relation with the number of stems they produced.

3.5 Medium tuber yield (t ha $^{-1}$)

The mean data shows that highest medium tuber yield (11.67 t ha^{-1}) were recorded in CIP-39007-55 followed by CIP-393574-6 (7.73 t ha^{-1}) and CIP-966239-131

(6.78 t ha^{-1}), while the minimum medium tuber yield (0.20 t ha^{-1}) were recorded in genotype CIP-394054-120 followed by CIP-391202-21 (0.83 t ha^{-1}) and CIP- 394012-96 (0.95 t ha^{-1}).

The genotype CIP--39007-55 and CIP-394574-6 medium tuber yield was significantly high from the check cultivar Karoda. The CIP-39007-55 produced the maximum medium tuber yield from the rest potato germplasm. The medium tuber yield is a good character of a variety because the medium tuber market value.

3.6 Large tuber yield (t ha $^{-1}$)

The mean data shows that the highest large tuber yield (6.31 t ha^{-1}) were recorded in genotype CIP-393574-6 followed by Draga (5.12 t ha^{-1}) and Karoda (4.52 t ha^{-1}), while the minimum large tuber yield (0.00 t ha^{-1}) and (0.36 t ha^{-1}) were recorded in genotype CIP-396239-111 and CIP-396239-111.

The large tuber yield of genotype CIP-393574-6 is significantly high from check cultivar Karoda. The genotype CIP-393574-6 produced maximum large tuber yield from the rest of potato germplasm. The check cultivar Karoda and simply red produced optimum large tuber yield that might be due to the genetic character. Plaisted and Peterson (1967) stated that the potato germplasm received from Holand produced different size of large tuber and large tuber yield and reasoned that large tuber yield is genetically controlled.

3.7 Total tuber yield (t ha $^{-1}$)

The mean data shows that highest total yield (18.68 t ha^{-1}) were recorded in CIP-39007-55 followed by CIP-393574-6 (17.62 t ha^{-1}) and CIP-966239-131 (15.12 t ha^{-1}), while the lowest total yield (0.71 t ha^{-1}) were recorded in genotype CIP-394054-120 followed by CIP- 393574-61 (2.01 t ha^{-1}) and CIP-391202-111 (2.30 t ha^{-1}).

The three genotypes CIP-39007-55, CIP-393574-6 and CIP-966239-131 produced maximum total tuber yield from the check cultivar Karoda. The potential yield of a cultivar depends upon temperature, water supply and organic matter status of soil and balance supply of nutrient to the crop.

Khan *et al.* (2007) stated that the potato yield is correlated with the number of tuber and tuber size of medium and large tuber.

4. Conclusion

On the basis of the performance genotype CIP-39007-55, CIP-393574-6 and CIP-966622-131 are recommended for further evaluation and cultivation in Swat valley.

Table 1. Evaluation of potato germplasm for sprouting percentage, plant height (cm), number of stem plant^{-1} and number of tuber plant^{-1}.

Potato germplasm	Sprouting percentage	Number of stem plant^{-1}	Number of tuber plant^{-1}
394012-96	80.00 hi	3.00 cd	6.99 b-e
39007-55	86.67 ef	4.33 ab	10.50 a
393574-6	87.67 ef	4.66 a	8.33 b
393619-148	76.00 jk	3.33 b-d	7.49 bc
394054-120	80.00 hI	2.66 cd	0.99 i
394021-120	81.00 h	3.00 cd	4.83 fg
396206-72	94.67 c	2.66 cd	6.33 b-f
396240-6	90.00 de	3.33 b-d	7.33 b-d
966239-131	95.67 bc	3.66 a-c	7.66 bc
396622-111	77.33 ij	3.00 cd	5.16 e-g
393574-61	84.67 fg	2.66 cd	2.49 hi
Satilite	72.67 k	2.66 cd	5.33 d-f
Draga	81.67 gh	2.33 d	5.00 e-g
391202-21	82.33 gh	2.66 cd	5.66 c-f
96-25	93.00 cd	2.66 cd	3.16 gh
396239-111	99.00 ab	2.66 cd	5.33 d-f
Simply Red	80.33 hi	2.33 d	5.83 c-f
Karoda	100.00 a	3.66 a-c	5.83 c-f
LSD @ 0.05	3.79 .	1.10 .	2.04 .

Mean value of the same category is followed by different letters are significantly different from each other at P≤ 0.05 using LSD test.

Table 2. Evaluation of potato germplasm for No. of tuber plot^{-1}, small tuber yield (t ha^{-1}) and medium tuber yield (t ha^{-1})

Potato germplasm	Number of tubers plot^{-1}	Small tuber yield ha^{-1}	Medium tuber yield ha^{-1}
394012-96	168.50 b	3.1000 ab	6.31 b-d
39007-55	232.50 a	3.5733 a	11.67 a
393574-6	182.00 b	3.5733 a	7.73 b
393619-148	166.50 b	3.3333 a	6.31 b-d
394054-120	8.50 i	0.4800 d	0.20 i
394021-120	87.50 e-g	2.8567 a-c	4.04 e-h
396206-72	89.00 ef	2.8600 a-c	3.45 gh
396240-6	141.50 c	2.9800 a-c	5.47 c-f
966239-131	180.50 b	3.9300 a	6.78 bc
396622-111	64.00 gh	0.8333 d	3.45 gh
393574-61	49.50 h	0.8300 d	0.95 i
Satilite	98.00 ef	1.4300 cd	2.74 h
Draga	125.00 cd	1.6667 b-d	5.59 c-e
391202-21	24.33 i	0.5567 d	0.83 i
96-25	130.00 c	3.4500 a	4.16 e-h
396239-111	76.50 fg	1.0700 d	3.81 f-h
Simply Red	103.00 de	1.4300 cd	5.00 d-g
Karoda	127.00 cd	3.5700 a	6.19 b-d
LSD @ 0.05	24.551	0.6617	0.7161

Mean value of the same category is followed by different letters are significantly different from each other at P≤ 0.05using LSD test.

Table 3. Evaluation of potato germplasm for large tuber yield (t ha^{-1}) and total tuber yield (t ha^{-1}).

Potato germplasm	Large tuber yield (t ha^{-1})	Total tuber yield (t ha^{-1})
394012-96	2.61 e-g	12.02 de
39007-55	3.43 ce	18.67 a
393574-6	6.31 a	17.62 ab
393619-148	2.86 d-f	12.50 c-e
394054-120	0.00 i	0.71 k
394021-120	1.31 g-i	8.21 g-i
396206-72	1.30 g-i	7.62 h-j
396240-6	3.45 c-e	11.90 d-f
966239-131	4.40 bc	15.11 bc
396622-111	1.67 f-h	5.95 ij
393574-61	0.53 hi	2.02 k
Satilite	2.01 e-h	5.59 ij
Draga	5.12 ab	12.38 c-e
391202-21	1.54 f-i	2.30 k
96-25	2.01 e-h	9.04 f-h
396239-111	0.36 hi	5.23 j
Simply Red	4.17 b-d	10.59 e-g
Karoda	4.52 bc	14.28 cd
LSD @ 0.05	0.667 .	2.901 .

Mean value of the same category is followed by different letters are significantly different from each other at P≤ 0.05using LSD test.

REFERENCES

Abbasi, N. A., I. A. Hafiz and B. Fazal. 2006. Evaluation of exotic potato varieties in ecological conditions of Islamabad during autumn season. Int. J. Agri. & Bio.1560-8530.

Abdel-Aal, Z. S., A. A. Khalf-Alla, M. Al-Shal and M. A. Qader. 1977. Vegetable Production. Al-Jadida Publisher Alexandria. Pp. 15-57.

Anonymous. 2009. FAO production year book. 39(128-9).

Anonymous. 2009. Ministry of Food Agriculture and Livestock, Federal Bureau of Statistic Islamabad, Pakistan.

Davis, H. T. 1967. The influence of stem thinning on tuber size. American Potato J. 46(287-290).

Farooq, K., M. M. Mahmood, R. Sher, D. I. Khan and A. R. Khan. 2002. Evaluation of CIP poato germplasm for late blight resistence during summer season in Sharan, Kaghan valley. Asian J. Plant Sci. 2(195-96).

Hijmans, R. and K. Paul. 2001. Global distribution of the potato crop. American J. Potato Res. 78 (6): 403-12.

Khan, A., H. Rahman, M. K. RAahman. A. Bari. 2005. Development of hybride potato and open pollinated potato seed. Pak. J. Botony. 2(58-62).

Khan, S. M., N. Jan, Iltafulllah, M. Younas and Hidayatullah. 2007.Evaluation of various methods of fertilizer application in potato. *Sarhad J. Agric. 23(4).*

Plaisted, B. L. and L. C. Peterson. 1967. Walse, a new variety for large tuber production. American Potato J. 44((287-91).

Sadique, M. A., M. G. Rabbani and M. I. Azad. 1987. Effect of seed size, number of eyes in seed piece and plant spacing on yield of potato. Bangladesh J. Agri. 12(73-81).

Tariq, A. H., M. Sadiq, F. Hamid, M. Iqbal, Asghar, K. A. 2008. Screening of CIP white skinned potato germplasm at Vegetable Research Institute, Faisalabad. Proce. Pakistan April. Pp. 277-283.

Winch, T. 2006. Growing Food: A Guide to Food Production. Springer Sci. Bus. Media. 7(35-36).

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar