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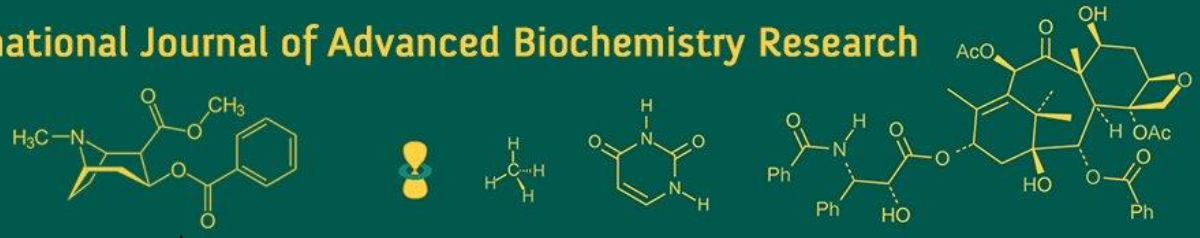

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Innovative strategies for mitigating potato virus: Exploring the interplay of planting arrangements, tuber size, and biocontrol

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Abstract
The FAO has classified potatoes (*Solanum tuberosum*) as "Food for Future" Due to its high productivity and high nutritional content. It is the world's fourth most important food crop (Ezekiel *et al*. 2013; Zhang *et al*. 2016) With a production and productivity of 51.31 million MT and 24.00 t/ha, respectively, across an area of 2.14 million ha, India comes in second place to China. However, in order to meet the demands of a growing population and economy, it is estimated that India will need to produce 55.00 and 122 million MT of potatoes by 2025 and 2050, respectively. Because potatoes offer a substantially higher economic yield per unit area and unit time, they have gained importance in areas with limited cultivable land. The most significant issue with the vegetative form of propagation of potatoes, which is through tubers, is the gradual and substantial reduction in the yield potential of seed tubers over time, a phenomenon known as "degeneration." It is now well acknowledged that viruses, phytoplasmas, and viroids-which proliferate throughout subsequent clonal generations—are the cause of degeneration. Thus, there is always a chance that they will be introduced using planting material to new locations. Large-scale economic losses in potato crop is caused by viral infections, especially in warm, humid climates where the conditions are perfect for the spread of viruses and their vectors. The purpose of this study work is to investigate the complex interactions between tuber size, planting arrangements, and bio-inoculants in an attempt to develop thorough and efficient solutions. It is crucial to comprehend the way these factors affect the prevalence of potato viruses as the farming environment changes.

Keywords: Potato, Viruses, tuber size and planting arrangements

Introduction
Potatoes (*Solanum tuberosum*) have become the third most significant food crop in the world for human consumption, after rice and wheat. The potato has every quality needed to be a promising food crop. Compared to many other crops, it yields significantly more dry matter, protein, and edible energy per unit area and time. Potato tubers are a healthy, nutrient-dense food. It offers high-quality nutritional fibre, proteins, minerals, vitamin C, several B group vitamins, and carbs. Conversely, it is still utilised in our nation as a dietary supplement. India consumes a meagre 15 kg of fresh potatoes year per person, while Denmark and the Netherlands consume 193 and 126 kg annually per person, respectively. Compared to other main staple crops, potato production has expanded at a significantly faster rate globally during the previous few decades. Because of their capacity to produce large amounts of digestible energy per unit time and unit area for household consumption while also earning income as a cash crop. It is one of the most significant industrial crops, and the majority of the uses for its starchy tubers are in food and feed. Consequently, there is a great deal of potential to grow the nation's potato output and consumption.
There are several threats to this type of crop, and viruses are one of the main ones that cause significant reductions in both quality and yield. In potato cultivation, viruses are one of the most important biotic obstacles. Nonetheless, when temperatures rise, virus vectors frequently proliferate and the frequency of viral outbreaks rises as well. Potato virus diseases are especially important in developing countries because of the rise in insect vectors and virus disease prevalence, as well as the lack or weakness of virus-tested seed systems.

The primary cause of the decline in seed potato quality is viruses, which are disseminated by aphids. Virus diseases infecting seed tubers were the primary cause of the degeneration issue, despite the initial belief that the problem was directly related to the asexual propagation of potatoes. Since viruses are systemic in nature, once they get inside the seed tuber, they reside there and continue to grow for many generations. The rate of degeneration was extremely high in the Indian plains because warmer subtropical climates are the most conducive to viral infection and spread. Potato leaf roll virus is a major threat to the world's potato crop, impacting quality, yield, and long-term economic viability. In an effort to improve crop resilience and practise sustainable agriculture, research has been explored novel approaches to reduce the prevalence of potato viruses. By dissecting the intricate relationships between them, scientists prefer to provide insightful knowledge that can guide the creation of innovative potato growing techniques that will provide a better protection against viral diseases. This study emphasises the value of integrated approaches in boosting crop health and productivity, not only in relation to the immediate issues of virus management but also in line with the larger objective of sustainable agriculture.

Materials and Methods

Potato tuber seed

ICAR-Central Potato Research Station, Jalandhar (Punjab) provided potato tuber seed of variety Kufri Pukhraj for research study.

3 planting arrangements (A) i.e, (A_1) 60cm × 20cm, (A_2) 60cm × 30 cm and (A_3) 60cm × 40 cm and 3 tuber sizes (B) i.e, Small (B_1), medium (B_2) and large sized tubers (B_3) were used in the study

Biocontrol

Source of biocontrol was Division of Microbiology, Faculty of Basic Science SKUAST- Jammu, Three biocontrols were used in the research study *Pseudomonas fluorescens* (C_1), *Trichoderma viride* (C_2), *Beauveria bassiana* (C_3) *and* Control (C_0)

Virus incidence (%): The virus incidence was calculated by given formula:

$$\text{Virus incidence} = \frac{\text{Number of infected plants}}{\text{Total number of plants observed}} \times 100$$

Symptoms: Infected plants were calculated by identifying the symptoms of virus. One of the most common viral illnesses affecting potatoes in India is the potato leafroll virus. Plants that are infected only yield a modest to medium number of tubers. It is the type species of the Luteoviridae family's genus *Polerovirus*. Small, isometric virions (23–25 nm in diameter) are the hallmark of PLRV, and they are mostly restricted to the phloem of infected plants. Only the top young leaves exhibit the main symptoms; in some cultivars, these leaves typically stand straight, roll, and become slightly pale. Growing the plants from infected seed tubers causes secondary symptoms to appear. These signs are either absent or less noticeable on younger upper leaves, but they are very noticeable on older leaves. The distinctive look of infected plants is pale, dwarfed, and upright, with rolling lower leaves that become yellow, brittle, and have a leathery texture. Certain cultivars exhibit a crimson or purple discoloration on the underside and margins of their leaves.

Statitical analysis

Experimental data will be subjected to statistical analysis as per the Split Plot Design to draw the inferences of the study. Using OPSTAT software developed by Sheoran *et al*. (1998) [5], the data will be statistically analysed with three factor analysis. The critical difference (C.D.) shall be used to determine the major differences between the means of two-treatments.

Result

Data illustrated in table 1. showed the interactive effect of planting arrangements with tubersize-biocontrol which was found to be significantly affected the virus incidence. Minimum virus incidence (43.38%) was found in B_3C_3 which was large tuber size inoculated with *Beauveria bassiana* whereas maximum incidence (73.32%) was found in B_1C_0 in which small sized tubers planted in controlled plot where no biocontrol where applied. It was also found in the table that different planting arrangements had no significant effect on virus incidence.

Table 1: Interactive effect of planting arrangements and tubersize-biocontrol on virus incidence.

	A_1	**A_2**	**A_3**	**mean**
B_1C_0	74.58	72.45	72.93	73.32
B_1C_1	70.03	70.28	56.95	65.76
B_1C_2	58.56	56.62	57.08	57.42
B_1C_3	52.98	51.20	62.20	55.46
B_2C_0	70.02	67.12	65.33	67.49
B_2C_1	67.02	64.28	58.62	63.31
B_2C_2	60.27	59.28	53.58	57.71
B_2C_3	51.55	47.45	47.62	48.87
B_3C_0	58.73	51.28	62.30	57.44
B_3C_1	59.33	49.95	59.20	56.16
B_3C_2	42.28	47.55	50.10	46.64
B_3C_3	44.03	42.12	43.99	43.38
Mean	59.11	56.63	57.49	
LSD (P=0.05)				
A	BC	A*BC		
NS	2.45	4.24		

Data depicted in table 2 indicated the individual and interactive effect of planting arrangements and tubersize on virus incidence. It was found that potato plants planted with large tuber size (B_3) had minimum incidence of virus (50.91%) and maximum incidence of virus (62.99%1) was found in small tuber size B_1. Whereas, it is clearly indicated in table 3 that individual and interactive effect of tubersize and biocontrol on virus incidence had significant effect on virus. Minimum incidence of virus (49.24%) was reported in plants treated with biocontrol *Beauveria bassiana* and maximum incidence of virus (66.08%) was found in control where no biocontrol was applied.

Table 2: Individual and interactive effect of planting arrangements and tubersize on virus incidence

	B_1	**B_2**	**B_3**	**Mean**
A_1	64.04	62.21	51.09	59.11
A_2	62.64	59.53	47.73	56.63
A_3	62.29	56.28	53.90	57.49
Mean	62.99	59.34	50.91	
LSD (P=0.05)				
	A	B	A*B	
	NS	1.23	2.45	

Table 3: Individual and interactive effect of tubersize and biocontrol on virus incidence.

	B_1	**B_2**	**B_3**	**Mean**
C_0	73.32	67.49	57.44	66.08
C_1	65.76	63.31	56.16	61.74
C_2	57.42	57.71	46.64	53.92
C_3	55.46	48.87	43.38	49.24
Mean	62.99	59.34	50.91	
LSD (P=0.05)				
	B	C	B*C	
	1.23	1.41	2.45	

Similarly, Data presented in table 4 indicates that planting arrangements had no significant influence of virus incidence in plants. Though interaction effect of planting arrangement and biocontrol had significant effect on virus incidence in plants. Minimum incidence of virus (46.92%) was found in A_2C_3 i.e, plants planted in planting arrangement of 60cm × 30 cm applied with biocontrol *Beauveria bassiana*.

Table 4: Individual and interactive effect of planting arrangements and biocontrol on virus incidence

	C_0	**C_1**	**C_2**	**C_3**	**Mean**
A_1	67.77	65.46	53.70	49.52	59.11
A_2	63.62	61.51	54.48	46.92	56.63
A_3	66.85	58.26	53.58	51.27	57.49
Mean	66.08	61.74	53.92	49.24	
LSD (P=0.05)					
A	C	A*C			
NS	1.41	2.45			

Discussion

The occurrence of viruses is significantly influenced by tuber size. Potato yield and quality are both impacted by viral infection of potato plants, which lowers the starch content of tubers, reduces yield, and produces lower-quality tubers. Similar results were found by Liu *et al*., 2023 [2] and Ospankulova *et al*., 2023 [3]. Additionally, partial autoinfection was discovered in large potato tubers, suggesting that only a percentage of the daughter tubers of a plant that is subsequently infected by viruses may get infected based on the prevailing environmental circumstances. Whereas, As a biological control agent against insects, *Beauveria bassiana* is an entomopathogenic fungus. It has been reported to contain viruses, however these viruses are rarely linked to harmful outcomes for their hosts. It has been discovered that the existence of endophytic entomopathogenic fungus (EEPF) in plant tissues has an indirect impact on aphid-mediated viral transmission. Thus effectively control the transmission of virus in potato crop. The results were in also in conformity with Herrero *et al*., 2012 [4].

Conclusion

The research study concluded that plant population grown from large sized seed potato treated with bio-inoculants specifically *Beauveria bassiana* had least virus incidence. Whereas, planting arrangements had no significant impact on virus incidence.

References

1. Ezekiel R, Singh N, Sharma S, Kaur A. Beneficial phytochemicals in potato — a review. Food Research International. 2013;50:487-496.
2. Liu J, Yue J, Wang H, Xie L, Zhao Y, Zhao M, Zhou H. Strategies for Engineering Virus Resistance in Potato. Plants (Basel). 2023;12(9):1736
3. Ospankulova G, Khassanov V, Kamanova S, Toimbayeva D, Saduakhasova S, Bulashev B, *et al*. Effect of infection of potato plants by Potato virus Y (PVY), Potato virus S (PVS), and Potato virus M (PVM) on content and physicochemical properties of tuber starch. Food Science and Nutrition. 2023;11(7):4002-4009.
4. Herrero N, Dueñas E, Quesada-Moraga E, Zabalgogeazcoa I. Prevalence and diversity of viruses in the entomopathogenic fungus *Beauveria bassiana*. Applied and Environental Microbiology. 2012;78(24):8523-30
5. Sheoran OP, Tonk DS, Kaushik LS, Hasija RC, Pannu RS. Statistical Software Package for Agricultural Research Workers. Recent Advances in information theory, Statistics & Computer Applications by D.S. Hooda and R.C. Hasija Department of Mathematics Statistics, CCS HAU, Hisar, 1998, p. 139-143.
6. Zhang DQ, Mu TH, Sun HN. Domestic and abroad research progress of potato tuber-specific storage protein patatin. Scientia Agriculture Sinica. 2016;49:1746-1756.