Research Article

Potassium Effect on Thrips Infestation and Bulb Yield of Onion Varieties

Tayyeba Samreen

Soil Science Department, Directorate of Soil and Plant Nutrition, Agricultural Research Institute Tarnab, Peshawar, Khyber Pakhtunkhwa, Pakistan.

Abstract | Field experiments were conducted to examine the effect of Potassium fertilizer (K_2SO_4) on thrips infestation and yield of Swat-1 and Superstone Onion varieties grown at Agricultural Research Institute Tarnab, Peshawar. Potassium treatments were applied @ 0, 30, 40, 50, 60, and 70 (kg ha^{-1}) uniformly to both the varieties. Urea and Diammonium phosphate (DAP) were applied as the source of nitrogen and phosphorous respectively to all the experimental plots. The outcome of applied K was encouraging on both the varieties of onion. Potassium doses depressed thrips infestation (75 % in Swat-1 and 65 % in Superstone) and the effect improved with dose increase up to application of 60 kg ha^{-1}. The lowest yield i.e., weight of onion bulbs and number of marketable onions was observed in control without K treatment whereas maximum yield i.e., weight of onion bulbs and number of marketable onions was obtained when K was applied @ 60 kg ha^{-1}. This study suggests that the thrips population on the onion varieties could be well managed with the application of K @ 60 kg ha^{-1} to attain maximum quality production of onions yield.

Received | March 22, 2024; **Accepted** | May 05, 2025; **Published** | July 18, 2025
***Correspondence** | Tayyeba Samreen, Soil Science Department, Directorate of Soil and Plant Nutrition, Agricultural Research Institute Tarnab, Peshawar, Khyber Pakhtunkhwa, Pakistan; **Email:** tayyeba.samreen@yahoo.com
Citation | Samreen, T., 2025. Potassium effect on thrips infestation and bulb yield of onion varieties. *Sarhad Journal of Agriculture,* 41(3): 1105-1110.
DOI | https://dx.doi.org/10.17582/journal.sja/2025/41.3.1105.1110
Keywords | Onion, Thrips, Potassium, Swat-1, Superstone, Bulb yield

Introduction

Onion (*Allium cepa* L.) is one of the most vital vegetable crops grown in Pakistan for local consumption and export as well. Pakistan stand 9th among the top onion producers of the World where onion is being grown over an area of 0.138 million hectares with an overall production of 1.833 million tons (Khan *et al*., 2020). The production of onions per hectare in Pakistan remains nearly unchanged since 2001 which is reported to be due to poor planting densities, improper use of fertilizer, pest infestation and use of inferior quality seed (MNFSR, 2023).

Onion crops are subjected to a variety of diseases and attack by arthropod pests which can lessen crop yield and quality (Lorbeer *et al*., 2002). Pest development in primary stages and imbalanced nutrition is known to be responsible for low productivity in onion. The most harmful pests of onion worldwide are the insignificant looking thrips (*Thrips tabaci* L). They are observed wherever onion is grown, however they are worst in the warmer production regions (Brewster, 1994). Damage by thrips feeding not only results in silvering of the leaves, reduced bulb weight and damage marketable foliage but it also makes onion plants susceptible towards numerous fungal and bacteriological microorganisms which further reduce quality yield (Morse and Hoddle, 2006; Diaz-Montano *et al*., 2011).

Fertilizers in optimum utilization play a vital role in control of insects and increase of crop yield per unit area (Samreen *et al*., 2017). Potassium (K), along with nitrogen (N) and phosphorus (P), is an indispensable plant macronutrient acquired by crops from soils in comparatively large quantities (Imas, 2013). It is important in terms of abundance in plant tissues and physiological and biochemical functions. It has an irreplaceable role in the activation of enzymes that are fundamental to metabolic processes and maintains the water content. It also occupies a vital role in regulating crop yield and quality (Malakouti *et al*., 2005). Crops with an adequate supply could have a better appearance, taste, flavour and could also produce food free of the signs of pests and diseases (Imas, 2013).

Potassium (K) is essential component of cell wall and helps plant to grow strong stalks. Plants with proper K supply will have thicker cell wall and increased resistance to insects and pests. K nutrition assists the plant to sustain increased turgor, or water pressure in cells (Wang *et al*., 2013). Inadequate K supply induces a pale leaf colour which is predominantly appealing for insects. Wilting, usually observed with K shortage, is another attraction to insects when the attacking organism endeavours to push through the cell membrane (Zhang *et al*., 2024; Li *et al*., 2022). Physical resistance to pests is also improved because adequate potassium supply ensures complete closure of plant stomata. K shortage results in build-up of soluble N compounds and sugars, which are attractive sources of diet for parasites such as Onion fly, Lesser bulb fly, Thrips etc. Cracks, fissures and lesions that evolve at K scarcity on the surface of leaves and fruits offer easy access particularly for facultative parasites (Beaton *et al*., 1995).

The key objective of the present work is to evaluate the effect of various levels of potassium on thrips population and bulb yield in two onion varieties. Research findings will significantly contribute in helping farmers resolves the problem of facing low yield of onions per hectare.

Materials and Methods

Experimental site

Field experiments were carried out at Agricultural Research Institute Tarnab Khyber Pakhtunkhwa, Pakistan during Rabi, 2014.

Varieties

Two onion varieties, Swat-1 and Superstone were received from Research Station Mingora and D.I. Khan respectively. Onion seeds were sown in a seedbed from which the plants were transplanted to the field after 45 days.

Treatment details

This included treatment of potash @ 30, 40, 50, 60 and 70 kg ha^{-1}) and one control treatment.

Treat-ments	N kg ha^{-1} (urea)	P_2O_5 kg ha^{-1} (DAP)	K_2O kg ha^{-1} (SOP)
T_1	70	60	0
T_2	70	60	30
T_3	70	60	40
T_4	70	60	50
T_5	70	60	60
T_6	70	60	70

Fertilizer application

A fertilizer dose of 70 kg ha^{-1} N as urea and 60 kg ha^{-1} P as DAP (Diammonium phosphate) was uniformly given to all treatments including control. Potassium (K) was applied in the form of sulphate of potash (K_2SO_4). Full doses of DAP and SOP and half dose of urea were applied at the time of sowing (transplanting the onion nursery to the field). The remaining half dose of the urea was applied 30 days after transplanting the onion nursery to the field.

Field layout

There were six treatments including control each treatment was replicated thrice in a Randomized Complete Block Design. Plot size was 12 square meters. There were eight rows per plot. Row-row spacing was 30 cm and the plants were spaced 15cm apart within rows.

Top 330 at the rate of 100 ml per 10 litre water was sprayed as a pre- emergence weedicide. The effect was observed on thrips population, yield and yield components of onion.

R1	R2	R3
T_1	T_5	T_4
T_4	T_3	T_2
T_2	T_1	T_6
T_6	T_4	T_5
T_3	T_2	T_3
T_5	T_6	T_1

Thrips determination

Thrips data was recorded at the early bulb formation stage of the onion crop when there were six to eight leaves in plants. The data was taken by selecting 10 plants randomly in each plot and the number of Thrips were counted at their larval stage and then the mean was taken.

Field data

The bulb yield was determined by weighing the total harvested bulbs and the total yield tons per hectare was calculated by dividing the bulb yield per plot by the area of plot in m^2 and multiplying with 10,000 m^2.

Statistical analysis

The data analysis was performed in excel by selecting the Anova single factor at the alpha level 0.05 (level of significance) to compare the treatment means. The mean differences among the treatments were compared by the post hoc tests by the Fisher's Least Ssignificance Difference test (LSD), Tukeys's Honestly Significance Difference test (HSD) and Scheffe's test.

Results and Discussion

The outcome of different levels of K on the number of thrips/plant on Superstone and Swat-1 varieties is presented in Figure 1. Figure 1 shows that maximum number of thrips were recorded in control followed by 30, 40, 50 kg ha^{-1} application of Potash and minimum in plants treated with 60 kg ha^{-1}. The number of thrips per plant on Swat-1 variety was decreased by 75% over control in 60 kg ha^{-1} treatment. This proved that thrips flourish more on plants that were grown in soil without K. Figure 1 also reveals the effect of K on number of thrips/plant on Superstone onion variety. The data shows that number of thrips/ plant is maximum in control plots and minimum in 60 kg. ha^{-1} treatment. The decrease in the number of thrips per plant in 60 kg ha^{-1} was 65.5 % over control. Similar observations were previously reported in the literature (Imas, 2013; Prajapati and Modi, 2012). Comparison of the thrips infestation on Superstone with Swat-1 variety shows that the number of thrips/ plant is less in Swat-1 than recorded on Superstone variety. This trend was observed in control and is also followed with K doses while the dose 60 kg ha^{-1} is noted to be the optimal dose for both the varieties showing minimum number of thrips. Potassium is reported to enable plant develop stronger cell walls, an increase in the production of high-molecular-weight compounds (proteins, starches and cellulose) and phenol which protects the plant against any pest attack (Mengel, 2001; Prasad *et al*., 2010). These findings show that the Swat-1 variety is relatively more resistant to thrips.

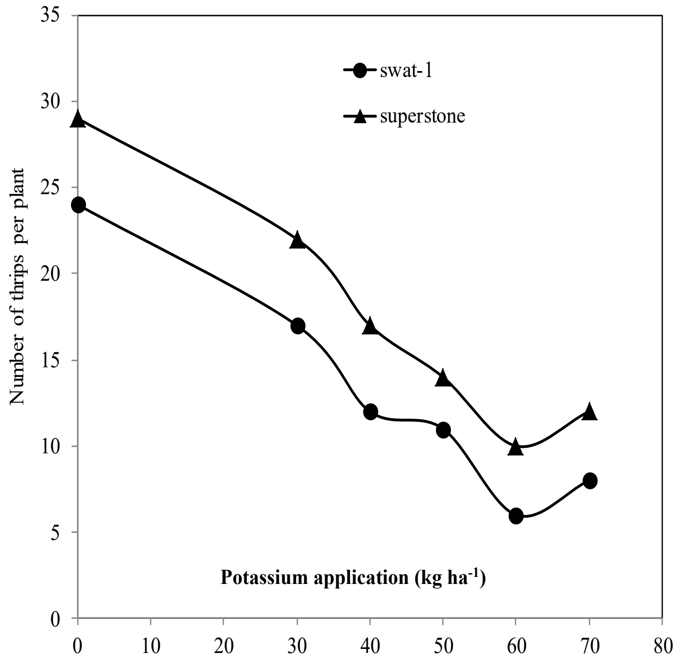

Figure 1: *Effect of potassium application with different rates on population of thrips/plant on Onion varieties.*

The effect of K on weight and number of marketable and non-marketable onions is given in Tables 1, 2. The data were statistically analysed with the help of ANOVA-1 to compare the treatment means (Tables 3, 4). In Swat-1 variety (Table 1) the weight and number of marketable onions was maximum in plots treated with 60 kg/ha K and minimum in control plots however, above 60 kg ha^{-1} K the effect was unfavourable. Potassium is positively charged and is held relatively loose on the exchange sites in soil. Generally, the potassium-supplying capacity of a soil is better with higher cation exchange capacity (CEC). Excess potassium may behave toxic and reduce plant growth (Sullivan *et al*., 2001). Similar trend was observed by Islam *et al*. (2008). They observed that application of potassium at 120 kg ha^{-1} developed

Table 1: *Effect of K on yield of Swat-1 onion variety.*

Treatment details	Marketable onion bulbs (t ha^{-1})	Non-marketable onion bulbs (t ha^{-1})	No of marketable onion (ha^{-1})	No of non-marketable onion (ha^{-1})
$N_{70}P_{60}K_0$ (K0)	3.25	0.94	135625	34375
$N_{70}P_{60}K_{30}$ (K1)	3.69	0.44	137500	33125
$N_{70}P_{60}K_{40}$ (K2)	4.00	0.63	139375	27500
$N_{70}P_{60}K_{50}$ (K3)	4.25	0.63	141250	20625
$N_{70}P_{60}K_{60}$ (K4)	4.69*	0.31	148750	20625
$N_{70}P_{60}K_{70}$ (K5)	3.75	0.63	140625	22500

refers to the highest value achieved, Values are mean of three replicates, t ha^{-1} = tonnes per hectare

Table 2: *Effect of K on yield of Superstone onion variety.*

Treatment details	Marketable onion bulbs (t ha^{-1})	Non-marketable onion bulbs (t ha^{-1})	No of marketable onion bulbs (ha^{-1})	No of Non-marketable onion (ha^{-1})
$N_{70}P_{60}K_0$ (K0)	2.50	3.25	73125	22500
$N_{70}P_{60}K_{30}$ (K1)	3.13	0.88	84375	20000
$N_{70}P_{60}K_{40}$ (K2)	3.25	0.75	84375	16250
$N_{70}P_{60}K_{50}$ (K3)	3.25	0.75	87500	13750
$N_{70}P_{60}K_{60}$ (K4)	3.63*	0.69	97500	18750
$N_{70}P_{60}K_{70}$ (K5)	2.94	0.94	82500	21875

refers to the highest value achieved, Values are mean of three replicates, t ha^{-1} = tonnes per hectare.

Table 3: *Post Hoc analysis of Yield (t ha^{-1}) of onion varieties after ANOVA-1.*

Treatment	V1 (marketable and non-marketable)	V2 (marketable and non-marketable)	Mean
$N_{70}P_{60}K_0$ (K0)	4.19	4.57	4.97a
$N_{70}P_{60}K_{30}$ (K1)	4.13	4.01	4.07a
$N_{70}P_{60}K_{40}$ (K2)	4.63	4.00	4.32a
$N_{70}P_{60}K_{50}$ (K3)	4.88	4.00	4.44a
$N_{70}P_{60}K_{60}$ (K4)	5.00	4.32	4.66a
$N_{70}P_{60}K_{70}$ (K5)	4.38	3.88	4.13a
Mean	4.54	4.33	

**V1= swat-1 variety, V2= superstone variety the mean followed by similar letter (s) are not significantly different at p=0.05*

Table 4: *Post Hoc analyses of total no. of onion varieties (ha^{-1}) after ANOVA-1.*

Treatment	V1 (no. of marketable and non-marketable)	V2 (no. of marketable and non-marketable)	Mean
$N_{70}P_{60}K_0$ (K0)	170000	95625	132812a
$N_{70}P_{60}K_{30}$ (K1)	170625	104375	137500a
$N_{70}P_{60}K_{40}$ (K2)	166875	100625	133750a
$N_{70}P_{60}K_{50}$ (K3)	161875	101250	131562b
$N_{70}P_{60}K_{60}$ (K4)	169375	116250	142812ab
$N_{70}P_{60}K_{70}$ (K5)	163125	104375	133750c
Mean	140000	103750	135364

**V1= swat-1 variety, V2= superstone variety the mean followed by similar letter (s) are not significantly different at p=0.05*

maximum bulb yield (14.76 t ha^{-1}) and further increase in the dosage of potassium did not display any growth in yield of onion. They also noted the lowest bulb yield (7.94 t ha^{-1}) from control (0 kg ha^{-1} potassium). The increase in weight of marketable onion and number of marketable onion bulbs in plants treated with 60 kg ha^{-1} K was 30 % and 9 %, respectively over the control. In contrast, the number and weight of non-marketable onion was in ascending order from control to 60 kg ha^{-1} K treatment. The decrease in weight and number of non-marketable onion in 60 kg ha^{-1} K was 67 % and 40 % over control.

The weight and number of marketable onion bulbs recorded in Superstone variety were maximum in 60 kg ha^{-1} K and minimum in control which is somewhat similar to the trend observed in Swat-1 variety (Table 2). The increase in weight of marketable onion bulbs was 31 % in 60 kg ha^{-1} K treatment over control. The number and weight of non-marketable onion was in ascending order from control to 60 kg ha^{-1} K. The decrease in weight and number of non-marketable onion in 60 kg ha^{-1} K was 79 % and 17 % respectively over control. The weight of marketable onion bulbs per hectare in Swat-1 significantly increased from 5.2

in control to 7.5 kg ha^{-1} with K level of 60 kg ha^{-1} while in Superstone the weight of marketable onion increased from 4.0 to 5.8 kg ha^{-1}. The results observed here are in agreement with the conclusions of Jiang *et al*. (1998) and Nagaich *et al*. (1998). Onions, remove nearly as much potash as nitrogen for production (Halliday and Trenkelm, 1992). Hence, for better yield the use of fertilizers in a well-balanced proportion is mandatory. The present results illustrated potassium application as fundamental constituent of balanced fertilizers application for high yield. Thus, in the present studies, 60 kg ha^{-1} potassium proved to be in balance ratio with N and P fertilizers.

Conclusions and Recommendations

Potassium treatments @ 60 kg ha^{-1} significantly increased yield of both the onion varieties. The yield, weight and number of marketable onions also increased with potassium doses compared to control and the effect was more prominent at 60 kg ha^{-1} dose rate. Potassium doses depressed thrips infestation and the effect improved with dose increase till 60 kg ha^{-1}. Swat-1 variety was comparatively more resistant to thrips infestation and yielded more production as compared to Superstone variety. Upto 60 kg ha^{-1} application of K was tolerable and suggested to growers for field application to get good quality crop and high yield of onion in Peshawar region of Khyber Pakhtunkhwa.

Acknowledgements

I am grateful to Agricultural Research Institute Tarnab Peshawar for providing all research facilities in completion of the project timely.

Novelty Statement

Application of potassium doses improved the bulb weight, quality yield of onions and is also observed to be a contributing parameter in depressing thrips infestation a critical problem for farmers.

Conflict of interest

The authors have declared no conflict of interest.

References

Brewster, J.L., 1994. Onions and other vegetable alliums. Horticulture Research International, Wellesbourne, CAB International.

Beaton, J.D., M.D. Stauffer, K.H. Gill and H. Rehman. 1995. Potassium research and development in Pakistan, PARC.

Diaz-Montano, J., M. Fuchs, B.A. Nault, J. Fail and A.M. Shelton. 2011. Onion thrips (Thysanoptera: Thripidae): A global pest of increasing concern in onion. J. Econ. Entomol., 104: 1-13. https://doi.org/10.1603/EC10269

Halliday, D.J. and M.E. Trenkelm. 1992. IFA world fertilizer use manual, International Fertilizer Industry Association. Paris, France.

Islam, M.A., A.T.M. Shamsuddoha, M.S.I. Bhuiyan and M. Hasanuzzaman. 2008. Response of summer onion to potash and its application methods. Am. Eurasian. J. Agron., 1(1): 10-15.

Imas, P., 2013. Potassium the quality element in crop production, international potash institute. Baumgärtlistrasse 17, P.O. Box 260 CH-8810 Horgen, Switzerland.

Jiang, Q., H. Zhang, G. Ai, Q.S. Jiang and H.L. Zhang. 1998. Application of potassium fertilizer in onion production, China-Vegetables. Liangshan Agricultural Bureau Liangshan. Shandong 272600, China.

Khan, A., A. Mubarik and Y. Aqsa. 2020. onion cluster feasibility and transformation study. In: (ed. A. Mubarik). Cluster development based agriculture transformation plan vision-2025. Project No. 131(434)PC/AGR/CDBAT-120/2018. Planning Commission of Pakistan, Islamabad, Pakistan and Centre for Agriculture and Biosciences International (CABI). Rawalpindi, Pakistan.

Li, P.J., W. Hu, Z. Lu, F. Meng, R. Cong, X. Li, T. Ren and J. Lu. 2022. Imbalance between nitrogen and potassium fertilization influences potassium deficiency symptoms in winter oilseed rape (*Brassica napus* L.) leaves. Crop J., 10(2): 565-576. https://doi.org/10.1016/j.cj.2021.06.001

Lorbeer, J.W., T.P. Kuhar and M.P. Hoffmann. 2002. Monitoring and forecasting for disease and insect attack in onions and allium crops within IPM strategies. In: (eds. H.D. Rabinowitch and L. Currah). Allium crop science: Recent advances, CABI, Wallingford, U.K. https://doi.org/10.1079/9780851995106.0293

Morse, J.G. and M.S. Hoddle. 2006. Invasion biology of thrips. Ann. Rev. Entomol., 51: 67-89. https://doi.org/10.1146/annurev.

ento.51.110104.151044

Malakouti, M.J., A.A. Shahabi and K. Bazargan. 2005. Potassium in Iranian agriculture, Sana Publication Co., Ministry of Jihad-e-Agriculture. Tehran, Iran.

Mengel, K., 2001. Principles of plant nutrition, 5th ed.; Kluwer Academic Publishers. Dordrecht, The Netherlands. 481–509.

MNFSR, 2023. Year book 2021-22, Government of Pakistan Ministry of National Food Security and Research Economic Wing Islamabad.

Nagaich, K.N., S.K. Trivedi, L. Rajesh and R. Lekhi. 1998. Effect of sulphur and potassium fertilization in onion (*Allium cepa* L.). South Indian Hortic., 46(3-6): 266-271.

Prasad, D., R. Singh and A. Singh. 2010. Management of sheath blight of rice with integrated nutrients. Indian Phytopathol., 63: 11–15.

Prajapati, K. and H.A. Modi. 2012. The importance of potassium in plant growth. A review. Indian J. Plant Sci., 1: 177-186.

Samreem, T., H. Humaira, S. Shah, S. Ullah and M. Javid. 2017. Zinc effect on growth rate, chlorophyll, protein and mineral contents of hydrophonically grown mungbeans plants (*Vigna radiata*). Arab. J. Chem., 10: S1802-1807. https://doi.org/10.1016/j.arabjc.2013.07.005

Sullivan, D.M., B.D. Brown, C.C. Shock, D.A. Horneck, R.G. Stevens, G.Q. Pelter and E.B.G. Feibert. 2001. Nutrient management for onions in the Pacific Northwest, A Pacific Northwest Extension Publication Oregon State University. Washington State University.

Wang, M., Q. Zheng, Q. Shen and S. Guo. 2013. The critical role of potassium in plant stress response through many mechanisms. Int. J. Mol. Sci., 14(4): 7370–7390. https://doi.org/10.3390/ijms14047370

Zhang., X., Z. Li, H. Lin and T. Wei. 2024. A phytoplasma effector destabilizes chloroplastic glutamine synthetase inducing chlorotic leaves that attract leafhopper vectors. Proc. Natl. Acad. Sci., 121(22): 1-12. https://doi.org/10.1073/pnas.2402911121