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# Effect of Different Doses and Splits of Potassium on Storage of Onion

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## Research Article

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**ABSTRACT**

The data found that, the physiological loss in weight, sprouting, rotting and black mould incidence were declined and number of marketable bulbs and TSS of bulb significantly increased during storage with increasing levels of potassium up to 60 kg $ha^{-1}$ ($K_3$) and with three split application of potassium ($S_3$) respectively. Combined effect of different levels of potassium and its split application was statistically significant with $K_3S_3$ i.e. three split application of 60 kg $ha^{-1}$ and maximum storage losses were obtained from $K_1S_1$ i.e. 40 kg $ha^{-1}$ of potassium 100 % at the time of transplanting.

## INTRODUCTION

Onion is vital commodity of masses and used as salad and cooked in various ways in curies, fried, boiled, baked and used in soup making and pickles. Besides fresh consumption, onion serves as very good raw material for processing industry as it is processed in the form of dehydrated powder, rings, shreds and onion in vinegar or brine. They are highly valued for their flavour and nutritional value in supplying minor constituents such as minerals and trace elements.

Potassium is eccentric element that plants can accumulate it in abundant amounts without any toxicity symptoms. This behaviour is referred to as luxury consumption. Potassium plays a regulatory role in plant mechanism. Potassium is not a component of any organic compound in plants. It improves drought tolerance. Neutralizes organic anions and other compounds and maintains the pH of cytoplasm in the range of 7-8. Triggers >60 enzymes, including starch synthetase, potassium is responsible for the activation of nitrate reductase enzyme, enhance its quality, shelf life of fruit and vegetables, reduce lodging of crops, enhance winter hardiness and imparts disease resistance. In the photosynthesis and carbohydrate metabolism in leaves. It increases the efficiency of metabolic and physiological processes of plants [1]. Potassium is involved in almost all the metabolic process in plant.

Potassium plays key role in onion production. Generally a heavy dose of fertilizer is recommended for onion cultivation. Similar to other tuber and root crops onion is very responsive to potassium. Among the various nutrients required to produce high yield of onion, potassium is considered to be very important element due to its influence for translocation of photosynthates, storage quality, bulb size, bulb numbers and yield per plot. Potassium is one of the three major nutrients taken up by the plant in large quantities and the adequate level of potassium increases crop resistance to various diseases, stalk and stem breakage and at stress conditions. Methods of application of potassium fertilizers have great impact on their utilization by the crop. Time of application of potassium during the growing period of onion is important in bulb formation. Satter and Haque [2] reported that split application of nitrogen and potassium gave higher weight of winter onion bulb than single application of same dose. Potassium helps in root development and increases the photosynthetic efficiency of leaves. Potassium exerts a balancing role on the effect of both nitrogen and phosphorous, consequently, it is especially important in multi nutrient fertilizer application [3]. The essential role of potassium in numerous physiological and biochemical processes in the plant - including photosynthesis, enhancing the translocation of assimilates, protein synthesis, maintenance of water balance, and promoting enzyme activities are well established [4]. Among the various nutrients required to produce high yield, potassium is considered to be a very important element due to its influence on translocation of photosynthesis, potassium deficiency dramatically reduced leaf area and dry matter accumulation and affected assimilate partitioning among plant tissues [5].

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India exports sizable quantities of onion (4.5 to 5 lakh tones) worth of Rs. 250-350 cores annually besides feeding the huge domestic population [6]. The onion industry in India faces turmoil very often due to sharp fluctuations in prices despite of strong support to export. Handling and marketing pose a greater problem during the glut season and fetch lower prices to the farmers; on the other hand, the consumer has to pay a heavy price during off season. For stabilization of onion prices, it is necessary to reduce the losses, develop proper storage structures and selection of the varieties having longer storage life and being better suited for processing. . Considering this view, the study was taken under on "Effect of different doses and splits of potassium on storage of onion", during Rabi 2015-16 with following objectives.

## MATERIALS AND METHODS

The research study entitled "Effect of different doses and splits of potassium on storage of onion" was implemented at the Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, during the rabi season of 2015-16. The experiment consists with four levels of potassium and three split applications. The effect of these combinations on growth, yield, quality and storage of onion was recorded. Akola is located at 307.415 meters above mean sea level and geographically situated at latitude of 220.421 and longitude of 770.021 E. This city has moderate rainy season, mild winter, relatively hot and dry summer. The meteorological data taken down at Meteorological Observatory, University Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the experimental period of 2015-16.The experiment was conducted in Factorial Randomized Block Design [7], with three replications and two factors i.e. factor 'A' viz., K -40 kg, $K_2$-50 kg , $K_3$-60 kg and $K_4$-70 kg of K $ha^{-1}$ and factor 'B' $S_1$-100 % at the time of transplanting , $S_2$-50 % at the time of transplanting +50 % at 30 DAT and S3-33.33 % at the time of transplanting +33.33 % at 30 DAT + 33.33 % at 60 DAT with 12 treatment combination.

The experimental plot was prepared by following proper cultural practices and mixed with well decomposed cow dung and all the fertilizers following the recommendation. Excluding nitrogen and potassium all other fertilizers were applied to the soil during final land preparation. Urea was applied to the soil in two equal splits. The first split was applied at the time of land preparation and second split after 30 DAT. The 55 days old seedlings with uniform growth were transplanted in the experimental plot on 20th January, 2016 by adopting spacing of 15×10 cm. intercultural operations were done whenever required like gap filling, weeding. First irrigation was given just after transplanting and subsequent irrigations were given at weekly intervals. The insect and diseases were controlled with appropriate control measures.

The bulbs of 'Akola Safed' were harvested at 50 % natural top fall during rabi season. The bulbs were cured for 4 days in the field and 2 weeks in shade and tops were cut by keeping 4 cm bulb neck the bulbs were graded and uniform samples of 100 bulbs of medium size for each treatment were stored in 3 replications and were kept under well ventilated room at ambient conditions. The stored bulbs were observed at monthly interval for recording total storage losses. The data recorded on various parameters of the study were statistically analysed using OP STAT at 5% level of significance.

## RESULT AND DISCUSSION

### Effect of Potassium Levels

At 30, 60, 90,120, 150 and 180 DAS significantly minimum physiological loss in weight (5.53%, 9.04%, 12.45%, 16.67%, 18.51% and 21.93 %), sprouting of bulbs (1.16, 2.31, 3.97and 7.09%) at 90, 120, 150 and 180 DAS, rotting of bulbs (2.88%, 5.29%, 6.18%, 8.02% and10.19%), levels of potash at 30, 60, 90, 120, 150 and 180 DAS and black mould incidence of bulbs (1.54%, 3.84%, 5.21% and 7.51%) at 60, 90, 120, 150 and 180 DAS respectively. Maximum number of marketable bulbs (97.85%, 97.84%, 94.17%, 89.85%, 82.66% and 77.88%) was recorded 30, 60, 90,120,150 and 180 DAS and TSS of bulbs There was a significant difference in respect of total soluble solids (13.88, 15.36 and 15.57) of onion bulbs at 0, 90 and 180 DAS were found significant and maximum storage loss recorded from $K_1$. Potassium increases bulb cellulose, controls plant turgidity, maintains integrity of cell membrane and reduces the water loss and thus play important role in reducing the storage losses of onion. Similar findings were recorded from Masalkar et. Al and Kale et al [8,9] **(Tables 1 and 2)**.

**Table 1:** Interaction effect of levels potassium and its split application on physiological loss in weight at various days after storage.

| Treatment combinations | Physiological loss in weight (%) | | |
|---|---|---|---|
| | 30 DAS | 120 DAS | 180 DAS |
| $K_1S_1$ | 7.62 | 18.52 | 24.62 |
| | 2.93 | 4.14 | 5.06 |
| $K_1S_2$ | 6.4 | 17.61 | 21.56 |
| | 2.72 | 4.31 | 4.75 |
| $K_1S_3$ | 5.8 | 16.52 | 19.62 |
| | 2.6 | -.18 | 4.54 |
| $K_2S_1$ | 7.38 | 18.27 | 23.72 |
| | 2.89 | 4.39 | 4.97 |
| $K_2S_2$ | 6.15 | 16.65 | 20.79 |
| | 2.67 | -4.2 | -4.66 |

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|---|---|---|---|
| $K_2S_3$ | 4.73 | 15.64 | 19.25 |
| | 2.39 | 4.07 | 4.5 |
| $K_3S_1$ | 6.8 | 18.14 | 22.78 |
| | 2.79 | 4.37 | 4.87 |
| $K_3S_2$ | 6.02 | 16.5 | 20.32 |
| | 2.65 | 4.18 | 4.62 |
| $K_3S_3$ | 3.77 | 15.38 | 18.61 |
| | 2.18 | 4.04 | 4.42 |
| $K_4S_1$ | 7.32 | 18.47 | 24.42 |
| | 2.88 | 4.41 | 5.04 |
| $K_4S_2$ | 6.31 | 17.43 | 21.01 |
| | 2.7 | 4.29 | 4.72 |
| $K_4S_3$ | 5.55 | 16.41 | 19.25 |
| | 2.55 | 4.17 | 4.51 |
| F test | Sig | Sig | Sig |
| SE (m) ± | 0.128 | 0.071 | 0.131 |
| CD at 5 % | 0.379 | 0.210 | 0.386 |

**Table 2:** Interaction effect of levels potassium and its split application on sprouting of onion at various days after storage.

| Treatment combinations | Sprouting of bulbs (%) | | | |
|---|---|---|---|---|
| | 90 DAS | 120 DAS | 150 DAS | 180 DAS |
| $K_1S_1$ | 2.58 | 3.76 | 6.14 | 9.81 |
| | 1.89 | 2.18 | 2.67 | 3.28 |
| $K_1S_2$ | 1.43 | 3.07 | 5.07 | 8.16 |
| | 1.55 | 2.01 | 2.46 | 3.02 |
| $K_1S_3$ | 1.05 | 2.13 | 3.79 | 6.83 |
| | 1.43 | 1.76 | 2.18 | 2.79 |
| $K_2S_1$ | 1.8 | 3.51 | 5.74 | 8.85 |
| | 1.67 | 2.12 | 2.59 | 3.13 |
| $K_2S_2$ | 1.12 | 2.94 | 4.72 | 7.53 |
| | 1.45 | 1.98 | 2.39 | 2.92 |
| $K_2S_3$ | 0.96 | 1.92 | 2.79 | 5.91 |
| | 1.4 | 1.7 | 1.94 | 2.62 |
| $K_3S_1$ | 1.57 | 3.25 | 5.22 | 8.62 |
| | -1.6 | 2.06 | 2.49 | 3.1 |
| $K_3S_2$ | 1.08 | 2.28 | 4.35 | 7.42 |
| | 1.44 | 1.81 | 2.31 | 2.9 |
| $K_3S_3$ | 0.83 | 1.4 | 2.35 | 5.23 |
| | 1.35 | 1.54 | 1.83 | 2.49 |
| $K_4S_1$ | 2.34 | 3.57 | 6.09 | 9.31 |
| | 1.82 | 1.13 | 2.66 | 3.21 |
| $K_4S_2$ | 1.36 | 2.52 | 4.88 | 7.93 |
| | 1.53 | 1.87 | 2.42 | 2.95 |
| $K_4S_3$ | 1 | 2.05 | 3.51 | 6.46 |
| | 1.41 | 1.74 | 2.12 | 2.73 |
| F test | Sig | Sig | Sig | Sig |
| SE (m) ± | 0.063 | 0.057 | 0.077 | 0.07 |
| CD at 5 % | 0.186 | 0.167 | 0.226 | 0.206 |

**Effect of Split Application of Potassium**

The split application of potassium, the minimum physiological loss in weight (4.96%, 8.18%, 11.94%, 15.99%, 16.86% and 19.22 % at 30, 60, 90, 120, 150 and 180 DAS),sprouting of bulbs (0.96%, 1.87%, 3.11% and 6.11% at 90, 120, 150 and 180 DAS), rotting of bulbs (2.45%, 4.64%, 5.45%, 6.56% and 9.47%) and black mould incidence (1.34%, 2.43%, 3.74%, 5.19% and 7.05%) at 60,90, 120, 150 and 180 DAS respectively and maximum number of marketable bulbs (98.19%, 97.88%, 95.57%, 91.27%, 86.23% and 81.64% at 30, 60, 90, 120, 150 and 180 DAS) and TSS of bulb (14.45, 16.01 and 16.20 at 0, 90 and 180 DAS) were recorded from treatment $S_3$ i.e. three split application of potassium and maximum storage losses were observed from $S_1$ i.e. 100 % at the time of transplanting. Split application of potassium was superior to its basal application **(Tables 3 and 4)**.

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**Table 3:** Interaction effect of levels potassium and its split application on rotting of onion at various days after storage.

| Treatment combinations | Rotting of bulbs (%) | | |
|---|---|---|---|
| | 60 DAS | 150 DAS | 180 DAS |
| $K_1S_1$ | 6.93 | 9.81 | 12.72 |
| | 2.33 | 3.28 | 3.7 |
| $K_1S_2$ | 5.87 | 8.17 | 11.24 |
| | 2.19 | 3.02 | 3.49 |
| $K_1S_3$ | 5.07 | 6.89 | 10.07 |
| | 1.94 | 2.8 | 3.32 |
| $K_2S_1$ | 6.55 | 8.79 | 11.86 |
| | 2.19 | 3.12 | 3.58 |
| $K_2S_2$ | 5.35 | 7.65 | 10.82 |
| | 2.05 | 2.94 | 3.43 |
| $K_2S_3$ | 4.52 | 6.61 | 9.37 |
| | 1.81 | 2.75 | 3.22 |
| $K_3S_1$ | 6.11 | 8.45 | 11.54 |
| | 2.1 | 3.07 | 3.54 |
| $K_3S_2$ | 5.64 | 7.14 | 10.32 |
| | 2.03 | 2.85 | 3.36 |
| $K_3S_3$ | 4.12 | 6.09 | 8.7 |
| | 1.75 | 2.66 | 3.11 |
| $K_4S_1$ | 6.84 | 9.5 | 12.44 |
| | 2.26 | 3.24 | 3.66 |
| $K_4S_2$ | 5.79 | 7.87 | 9.88 |
| | 2.12 | 2.97 | 3.29 |
| $K_4S_3$ | 4.85 | 6.68 | 9.76 |
| | 1.9 | 2.77 | 3.28 |
| F test | Sig | Sig | Sig |
| SE±(m) | 0.064 | 0.062 | 0.08 |
| CD at 5% | 0.19 | 0.184 | 0.236 |

**Table 4:** Interaction effect of levels potassium and its split application on black mould incidence of onion at various days after storage.

| Treatment combinations | Black mould incidence (%) | | | |
|---|---|---|---|---|
| | 60 DAS | 120 DAS | 150 DAS | 180 DAS |
| $K_1S_1$ | 2.86 | 4.97 | 7 | 11 |
| | 1.96 | 2.44 | 2.82 | 3.46 |
| $K_1S_2$ | 2.5 | 4.8 | 6.5 | 8.37 |
| | 1.87 | 2.4 | 2.73 | 3.06 |
| $K_1S_3$ | 1.5 | 4.25 | 6 | 8 |
| | 1.58 | 2.29 | 2.64 | 3 |
| $K_2S_1$ | 2.43 | 4.6 | 6.5 | 8.99 |
| | 1.85 | 2.36 | 2.73 | 3.16 |
| $K_2S_2$ | 1.6 | 4.51 | 5.6 | 8.34 |
| | 1.61 | 2.34 | 2.57 | 3.05 |
| $K_2S_3$ | 1.3 | 3.5 | 5 | 6.42 |
| | 1.51 | 2.12 | 2.71 | 2.72 |
| $K_3S_1$ | 1.81 | 4.28 | 6.35 | 8.54 |
| | 1.67 | 2.29 | 2.29 | 3.08 |
| $K_3S_2$ | 1.58 | 4 | 5 | 7.99 |
| | 1.6 | 2.23 | 2.44 | 2.99 |
| $K_3S_3$ | 1.24 | 3.23 | 4.28 | 6 |
| | 1.49 | 2.05 | 2.29 | 2.64 |
| $K_4S_1$ | 2.5 | 4.1 | 6.8 | 10 |
| | -1.87 | -2.23 | -2.79 | -3.31 |
| $K_4S_2$ | 2 | 4.5 | 6 | 8 |
| | -1.73 | -2.34 | -2.64 | -3 |

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|---|---|---|---|---|
| $K_4S_3$ | 1.35 | 4 | 5.5 | 7.78 |
| | -1.53 | -2.23 | -2.54 | -2.96 |
| F test | Sig | Sig | Sig | Sig |
| SE±(m) | 0.095 | 0.04 | 0.035 | 0.083 |
| CD at 5% | 0.28 | 0.133 | 0.102 | 0.246 |

**Interaction Effect**

Combined effect of different levels of potassium and its split application reported significant decline in storage losses [10]. The treatment combination $K_3S_3$ i.e. three split application of 60 kg $ha^{-1}$ recorded significantly minimum storage losses and while the treatment combination $K_1S_1$ i.e. 40 kg $ha^{-1}$ potassium 100 % at the time of transplanting.

## CONCLUSION

Among potassium levels minimum physiological loss in weight, sprouting, rotting, black mould incidence , maximum number of marketable bulbs and maximum TSS of bulbs were observed significantly superior in the treatment $K_3$ i.e. 60 kg of K $ha^{-1}$ and maximum losses in treatment $K_1$ i.e. 40 Kg K $ha^{-1}$.

In case of split application of potassium minimum physiological loss in weight, sprouting, rotting, black mould incidence, maximum number of marketable bulbs and maximum TSS were observed significantly superior in the treatment $S_3$ i.e. three split applications of potassium and maximum losses were observed from treatment $S_1$ i.e. 100% at the time of transplanting.

Combined effect of different levels of potassium and its split application recorded minimum storage losses. minimum Physiological loss in weight, sprouting, rotting, black mould incidence, maximum number of marketable bulbs and maximum TSS were observed significantly superior with treatment combination $K_3S_3$ i.e. 60 kg of K $ha^{-1}$ with three splits and maximum losses with treatment combination $K_1S_1$ i.e. basal application (100% at the time of transplanting) **(Tables 5 and 6)**.

**Table 5:** Interaction effect of levels potassium and its split application on marketable bulbs of at various days after storage.

| Treatment combinations | Marketable bulbs (%) | | | | | |
|---|---|---|---|---|---|---|
| Potash levels | 30 DAS | 60 DAS | 90 DAS | 120 DAS | 150 DAS | 180 DAS |
| $K_1S_1$ | 96.32 | 94.39 | 86.05 | 73.76 | 65.31 | 57.59 |
| | 78.91 | 76.27 | 68.04 | 59.16 | 53.89 | 49.34 |
| $K_1S_2$ | 97.37 | 96.39 | 93.22 | 90.51 | 80.52 | 72.71 |
| | 80.63 | 79.03 | 74.89 | 72.04 | 63.78 | 58.48 |
| $K_1S_3$ | 98.13 | 97.64 | 95.27 | 91.02 | 85.73 | 80.83 |
| | 82.1 | 81.14 | 77.43 | 72.56 | 67.78 | 64 |
| $K_2S_1$ | 96.53 | 94.85 | 92.14 | 86.62 | 75.48 | 69.58 |
| | 79.23 | 76.87 | 73.69 | 68.51 | 60.29 | 56.44 |
| $K_2S_2$ | 98.32 | 97.56 | 94.58 | 90.48 | 81.22 | 75.5 |
| | 82.53 | 80.98 | 76.53 | 72.01 | 64.29 | 60.3 |
| $K_2S_3$ | 98.31 | 97.67 | 95.47 | 91.03 | 86.89 | 81.52 |
| | 82.58 | 81.19 | 77.7 | 72.57 | 68.67 | 64.51 |
| $K_3S_1$ | 97.33 | 96.42 | 91.49 | 87.71 | 78.46 | 70.62 |
| | 79.07 | 80.56 | 73.02 | 69.46 | 62.32 | 57.15 |
| $K_3S_2$ | 98.54 | 97.63 | 94.78 | 89.44 | 82.57 | 80.39 |
| | 82.03 | 81.12 | 76.79 | 71.01 | 65.3 | 63.69 |
| $K_3S_3$ | 98.6 | 98.57 | 96.25 | 92.52 | 86.87 | 82.62 |
| | 83.21 | 83.1 | 78.87 | 73.97 | 68.73 | 65.33 |
| $K_4S_1$ | 97.35 | 96.34 | 86.79 | 86.38 | 66.31 | 64.57 |
| | 80.6 | 78.94 | 68.32 | 68.67 | 54.49 | 53.45 |
| $K_4S_2$ | 98.22 | 97.55 | 93.61 | 90.52 | 79.53 | 75.62 |
| | 80.96 | 82.3 | 75.34 | 72.04 | 63.07 | 60.38 |
| $K_4S_3$ | 97.72 | 97.46 | 95.31 | 90.3 | 85.52 | 81.61 |
| | 81.3 | 81.19 | 77.47 | 72.15 | 67.62 | 64.58 |
| F test | Sig | Sig | Sig | Sig | Sig | Sig |
| SE±(m) | 0.185 | 0.22 | 0.424 | 0.579 | 0.58 | 0.218 |
| CD at 5% | 0.545 | 0.65 | 1.25 | 1.709 | 1.713 | 0.642 |

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**Table 6:** Interaction effect of levels potassium and its split application on TSS of bulbs at various days after storage.

| Treatment combinations | TSS of bulbs (°B) | |
|---|---|---|
| | 90 DAS | 180 DAS |
| $K_1S_1$ | 13.86 | 14.61 |
| $K_1S_2$ | 14.97 | 15.21 |
| $K_1S_3$ | 16.06 | 16.27 |
| $K_2S_1$ | 13.91 | 14.23 |
| $K_2S_2$ | 15.24 | 15.44 |
| $K_2S_3$ | 16.18 | 16.28 |
| $K_3S_1$ | 14.22 | 14.42 |
| $K_3S_2$ | 15.67 | 15.83 |
| $K_3S_3$ | 16.2 | 16.46 |
| $K_4S_1$ | 13.86 | 14.27 |
| $K_4S_2$ | 14.97 | 15.05 |
| $K_4S_3$ | 15.59 | 15.8 |
| F test | Sig | Sig |
| SE±(m) | 0.061 | 0.073 |
| CD at 5% | 0.179 | 0.216 |

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