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Effect of micronutrients on storage losses of *kharif* onion (*Allium cepa* L.) *cv*. Phule Samarth

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ABSTRACT

The field experiment was carried out with an objective to study the effect of micronutrient application on both foliar or soil on storage losses of onion cv. *Phule Samarth* during *Kharif* 2019-20 at Tomato Improvement Scheme, Department of Horticulture, Mahatma Phule Krishi, Vidyapeeth, Rahuri. Dist. Ahmednagar, Maharashtra. The experiment was laid out in RBD (Randomized block design) having three replications with nine treatments. The results were analyzed on the basis of data with respect to storage losses attributes *viz*; PLW (Physiological loss in weight), sprouting loss and rotting loss as well as total loss at 30, 60 days after storage. Significant observations were recorded for the storage studies in *Kharif* onion cv. Phule Samarth. At 30 days after storage minimum total losses in storage (3.30 %) were recorded in treatment T_5 (T_1+Soil application of Phule micronutrient mixture grade I @ 25 kg/ha), while the maximum total losses were observed in treatment T_1 (Recommended dose of fertilizer *i.e*. 100:50:50 kg NPK/ha +20 t/ha FYM) (6.43 %). At 60 days after storage minimum total losses (7.44 %) were observed in treatment T_5 (T_1+Soil application of Phule micronutrient mixture grade I @ 25 kg/ha), which is at par with T_9 (T_1 + Foliar application of Phule Micronutrient mixture Grade II @ 0.5% at 30 and 45 DAT) (7.66 %), while the maximum total losses were observed in treatment T_1 (Recommended dose of fertilizer, *i.e*. 100:50:50 kg NPK/ha +20 t/ha FYM) (10.05 %). The cumulative effects of different micronutrient application system affect the storage qualities of onion.

Key words: *Onion, PLW, Sprouting, Rotting and Total loss.*

Introduction

Onion (*Allium cepa* L.) is one of the most important commercial vegetable commodities being grown in India and all over the world. According to Vavilov (1951) the primary centre of origin of onion lies in Central Asia. Onion is one of the major vegetable crops grown worldwide. Onion (*Allium cepa* L.), is the "Queen of Kitchen" called by the Germans (Gulshan, 1976) is one of the most important commercial crop not only in India but also in the world. India ranks second in area, production and productivity in the world. In India, Maharashtra is the leading state of onion production. The major area of onion production being concentrated in Nashik, Ahmednagar, Pune, Satara, Dhule, Jalgaon districts. Onion accounts for 70 percent of our total foreign exchange earnings from the export of fresh vegetables. In 2018, Government of India has declared onion as an essential commodity (Maurya *et al*., 2018). Generally, 100g of edible bulb of onion contains 86.6 g of moisture, 11.0 g of carbohydrates, 1.2 g of protein, 0.6 g of fiber and 0.4 g of minerals (Laxmi *et al*., 2019). They are high in vitamin C, vitamin B_6, folic acid and good source of dietary fiber.

Micronutrients play an active role in the plant metabolic process from cell wall development to respiration, photosynthesis, chlorophyll formation, enzymes activity, nitrogen fixation *etc*. Even though, micronutrients are needed by the plants in a minor quantities and present in plant tissue in quantities measured in parts per million but it is involved in a wide variety of metabolic processes and cellular functions within the plants. Also, they work as a co-enzyme for a large number of enzymes. In addition, they play an essential role in improving quality and highly required for better plant growth and yield of many crops (Ballabh and Rana, 2012).

Micronutrients play a vital role in enhancing crop productivity. Although, the requirement of micronutrients like zinc (Zn), boron (B), Copper (Cu), iron (Fe) and molybdenum (Mo) is indispensable because of their active role in plant metabolic process involving cell wall development, respiration, photosynthesis and nitrogen fixation. Selection of an effective application method depends on the micronutrient need, local soil conditions and the stage of crop growth growing season at which a deficiency is detected (Aske *et al., 2017).*

Onion is one of the diverse horticultural crop, which can be stored for quite a longer period. The storage is considered as an important aspect in postharvest life of onion. The objective of storage is to reduce the losses that occur during storage and hence increase the availability of onion. The stored onion gets deteriorated through metabolic breakdown, sprouting and microbial spoilage (Dabhi *et.al.* 2008). Hence, the knowledge on these causes becomes essential to minimize the storage losses and to extend the storability of onion. It is well established fact that the onion genotypes differ in storage attributes. Considering these, the an experiment was planned in order to find out the effect of micronutrient on storage losses of *kharif* onion *cv*. Phule Samarth, during the year *Kharif* 2019.

Materials and Methods

The present investigation entitled, "Effect of micronutrients on storage losses of *kharif* onion (*Allium cepa* L.) cv. Phule Samarth" was conducted at Tomato Improvement Scheme, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri during *kharif* season of 2019. The site is situated at $19^0 47'$ North latitude and in $74^0 19'$ East longitude and is 160 km to the North East of Pune city. The field selected for conducting the experiment was uniform in soil depth and texture. The soil was medium black and well drained. The experimental field at Rahuri falls in the semi-arid zone with an average rainfall of 475 mm having mean maximum and minimum temperature ranging from 25 to 41.25^0C & 7 to 24^0C respectively.

The experiment was laid out in a RBD (Randomized Block Design) with nine treatments and three replication. The crop was planted in a plot Size 3 m × 2 m flat bed at a spacing of 15 cm × 10 cm.

Details of the treatments and symbols used

Treatment	Treatment details
T_1	Recommended dose of fertilizer *i.e.*, 100:50:50 kg NPK/ha +20 t/ha FYM
T_2	T_1+ Soil application of Ferrous sulphate @ 25 kg/ha
T_3	T_1+ Soil application of Zinc sulphate @ 20 kg/ha
T_4	T_1+ Soil application of Borax @ 5kg/ha
T_5	T_1+ Soil application of Micronutrient mixture Grade I @ 25kg/ha
T_6	T_1+ Foliar application of Chelated Fe @0.20% at 30 and 45 days after transplanting
T_7	T_1+ Foliar application of Chelated Zn@ 0.20% at 30 and 45 days after transplanting
T_8	T_1+ Foliar application of Boric acid @ 0.20% at 30 and 45 days after transplanting
T_9	T_1+ Foliar application of Phule Micronutrient mixture Grade II @ 0.5% at 30 and 45 days after transplanting

The foliar application of treatment was carried out 30 and 45 days after transplanting. Soil application of micronutrients was done at the time of transplanting. The multi micronutrient mixture (Grade II) was used for the foliar application in treatment T_9 and Grade I was used for soil application at the time of transplanting in treatment T_8.

The soil samples of the experimental field were

Micronutrient/Content	Iron	Manganese	Zinc	Copper	Molybdenum	Boron
Grade I	2.0%	1.0%	5.0%	0.5%	0.0%	1.0%
Grade II	2.5%	1.0%	3.0%	1.0%	0.1%	0.5%

collected randomly up to 0-15 cm depth. The samples were air dried, grind well in wooden mortar, pestle and sieved through 2 mm sieve. The soil samples were analyzed from each plot separately for pH, EC, soil organic carbon; soil available N, P, K, Fe, Mn, Zn, Cu and B before planting and after harvest of crop according to standard methods.

The methods adopted for determination of soil fertility status and total nutrient uptake by onion crop for Soil analysis was pH (1:2.5) Potentiometric method and EC (ds/m) Conductometric method Jackson (1973). The organic Carbon (%) was estimated by wet oxidation method Nelson and Sommer 1982; Available N (kg/ha) by Modified Alkaline permagnate method Subbiah and Asija (1956); Available P (kg/ha) 0.5 M NaHCO3 at pH (8.5) Olsen *et al*. (1954); Available K (kg/ha) Flame photometry Knudsen *et al*. (1982); Micronutrients (Fe, Zn, Mn, Cu) by Atmospheric Absorption Spectrophotometer (DTPA extractant) Lindsay and Norvell (1978); Available Boron (Mg/kg) Extractable (Azomethine-H) John *et al.* (1975). The plant analysis was determined by the methods of Total N Micro- Kjeldahl's Distillation Jackson (1973); Total P Vanado Molybdate Phophoric acid Yellow Colour Jackson (1973); Total K Flame photometry Jackson (1973); Micronutrient (Fe, Zn, Mn, Cu) Atmospheric Absorption Spectrophotometer (DTPA extractant) Zoroski and Barua (1977); Total Boron 0.01 M $CaCL_2$ Extractable (Azomethine-H) John *et al*. (1975), respectively.

The harvested bulbs were field cured for about one week and then tops were cut leaving 2.5-3.0 cm neck length and then bulbs were kept for shade curing for 7-10 days. Curing in shade helps in development of more number of skin and also their retention for longer period. The grading was done as per recommended grades by APEDA and medium sized bulbs were kept for further storage studies. Each treatment having ten kg bulbs replicated thrice are kept for further storage studies in cages. After the harvesting ten kilograms of medium sized onion bulbs from each treatment were stored in cages in the month of December 2019. Which was well ventilated comprising temperature (26±30°C) and relative humidity (75±5%) to assess the storage studies. The observations were recorded at two month interval *i.e.*, 30 and 60 days after storage on sprouting losses, rotting losses, physiological loss in weight and total loss. The total loss was recorded at the end of storage period. The data recorded on various parameters were recorded and statistically analyzed as per the method given by Panse and Sukhatme (1985)

Results and Discussion

Analysis of variance showed significant differences among the treatments for all four characters- PLW (Physiological loss in weight), sprouting, rotting and total loss.

PLW (Physiological loss in weight)

The periodical physiological loss in weight of onion in storage was presented in Table 1. At 30 days after storage minimum physiological loss in weight (2.10 %) was recorded in treatment T_5 *i.e.* T_1+ Soil application of Phule micronutrient mixture grade I @ 25 kg/ha. while, maximum physiological loss in weight (3.90 %) was recorded in treatment T_1 (Recommended dose of fertilizer *i.e.* 100:50:50 kg NPK/ha +20 t/ha FYM) (2.84 %).

In case of 60 days after storage, minimum physiological loss in weight (6.00 %) was recorded in treatment T_5 (T_1+ Soil application of Phule micronutrient mixture grade I @ 25 kg/ha) and T_9 (T_1 + Foliar application of Phule Micronutrient mixture Grade II @ 0.5% at 30 and 45 DAT) (6.00 %) which are at par with T_3 (T_1 + Soil application of Zinc sulphate @ 20kg/ha) (6.12 %), while maximum physiological loss in weight (7.01 %) was recorded in treatment T_1 (Recommended dose of fertilizer *i.e.* 100:50:50 kg NPK/ha +20 t/ha FYM).

The micronutrient application significantly influences the physiological loss in weight at different combinations of nutrients along with control and climatic conditions prevailing during the storage time. The minimum loss in weight of bulb during storage is considered to be one of the desirable factors to increase storage life. In the present experiment, the bulbs showed a gradual increase in the physiological loss in weight (%) with the storage period in all the treatments.

The chemical must have played a vital role in modifying the rate of gaseous exchange that takes place through the surface of the bulbs by changing the ratio of carbon dioxide and oxygen inside the bulbs, thus minimizing the respiration and transpiration rate of the bulbs in turn must have reduced the rate of moisture loss and ultimately prevented the loss in weight reported by Singh and Dhankar (1989) in onion. Physiological loss in weight was positively and significantly correlated with moisture and neck thickness of onion bulbs (Kumar *et al*. (2000), Aske *et al*. (2017) and Kadam (2012).

Loss due to sprouting (%)

The data regarding rotting losses at 30 and 60 days after storage were presented in Table 1. Sprouting percentage of bulbs differed significantly due to different treatments. The loss due to sprouting increased with period of storage. The different treatments did not showed sprouting at 30 days after storage. At 60 days after storage, the following treatments did not showed any sprouting losses *i.e.* T_2 (T_1+ Soil application of ferrous sulphate @ 25 kg/ha), T_3 (T_1 + Soil application of Zinc sulphate @ 20kg/ha), T_5 (T_1+ Soil application of Phule micronutrient mixture grade I @ 25 kg/ha), T_6 (T_1 + Foliar application of Chelated Fe @ 0.20% at 30 and 45 Days After Transplanting), T_7 (T_1 + Foliar application of Chelated Zn@ 0.20% at 30 and 45 DAT), T_9 (T_1 + Foliar application of Phule Micronutrient mixture Grade II @ 0.5% at 30 and 45 DAT). While the treatment T_4 (T_1 + Soil application of Borax @ 5kg/ha) and T_8 (T_1 + Foliar application of Boric acid @ 0.20% at 30 and 45 DAT) shows the (0.03 %) and (0.01 %) sprouting losses. The maximum sprouting losses (0.20 %) were observed in the treatment T_1 (Recommended dose of fertilizer *i.e.* 100:50:50 kg NPK/ha +20 t/ha FYM).

Like other horticultural crops, onion continues to be metabolically active even after harvest, which tends to reduce the storage life due to sprouting whenever the conditions are favorable. Sprouting losses depend upon quantity of nutrients applied, climatic conditions during storage period. The increase in sprouting losses in storage might be due to higher dose of nitrogen might have produced thick necked bulbs, which increased sprouting due to greater access to oxygen and moisture to the central growing point, larger size of bulbs reported by Singh and Dhankar (1989). According to Madan and Sandhu (1983) bulb size and water content have inverse relationship with storage quality (Shinde *et al*.(2001) and Kadam (2012).

Loss due to rotting (%)

At 30 days after storage the minimum rotting losses (1.20 %) were observed in treatment T_5 (T_1+ Soil application of Phule micronutrient mixture grade I @ 25 kg/ha) followed by T_9 (T_1 + Foliar application of Phule Micronutrient mixture Grade II @ 0.5% at 30 and 45 DAT) (1.23%), T_8 (T_1 + Foliar application of Boric acid @ 0.20% at 30 and 45 DAT) (1.44 %), T_3 (T_1 + Soil application of Zinc sulphate @ 20 kg/ha) (1.46 %). While maximum rotting losses were observed in treatment T_1 (RDF*i.e.* 100:50:50 kg NPK/ha +20 t/ha FYM) (2.53 %).

At 60 days after storage, minimum rotting losses (1.44 %) were observed in the treatment T_5 (T_1+Soil application of Phule micronutrient mixture grade I @ 25 kg/ha) followed by treatments T_9 (T_1 + Foliar application of Phule Micronutrient mixture Grade II @ 0.5% at 30 and 45 DAT)(1.66%), T_3 (T_1 + Soil application of Zinc sulphate @ 20kg/ha) (1.83 %) and T_2 (T_1+Soil application of ferrous sulphate @ 25 kg/ha) (1.86 %) and maximum rotting losses observed in treatment T_1 (RDF *i.e.* 100:50:50 kg NPK/ha +20 t/ha FYM) (2.84 %).

Rotting losses was more in *kharif* crop storage pe-

Table 1. Effect of various micro nutrients on storage losses of *Kharif* onion cv. *Phule Samarth*

Trt.	*Kharif 2019*							
	PLW (%) days after storage		Sprouting losses (%) days after		Rotting losses (%) days after storage		Total loss (%) days after storage	
	30	60	30	60	30	60	30	60
T_1	3.90	7.01	0.00	0.20	2.53	2.84	6.43	10.05
T_2	3.81	6.85	0.00	0.00	1.68	1.86	5.49	8.71
T_3	3.01	6.12	0.00	0.00	1.46	1.83	4.47	7.95
T_4	3.20	6.59	0.00	0.03	2.21	2.33	5.41	8.95
T_5	2.10	6.00	0.00	0.00	1.20	1.44	3.30	7.44
T_6	3.01	6.59	0.00	0.00	2.05	2.33	5.06	8.92
T_7	3.18	6.18	0.00	0.00	2.18	2.38	5.36	8.56
T_8	3.80	6.90	0.00	0.01	1.44	2.62	5.24	9.53
T_9	2.98	6.00	0.00	0.00	1.23	1.66	4.22	7.66
SE (±)	0.19	0.05	0.00	0.02	0.11	0.14	0.21	0.14
CD 5 %	0.58	0.15	0.00	0.06	0.34	0.42	0.65	0.44

riod compared to the summer crop during storage period. This may be attributed due to high atmospheric humidity and rapid multiplication of already existing pathogens. Generally, excess N application develop vegetative growth of the plant, increase bulb size *i.e*. diameter of bulb, but lowers the storage quality while P and K improve it, Krishnan (1990) because both P and K are known to increase the dry matter accumulation as a result of increased photosynthetic rates.

There were significant differences in rotting losses in storage due to various treatments at different stage of observation. At storage of 30 days after storage maximum rotting losses (2.53%) were observed in treatment T_1 (RDF *i.e*. 100:50:50 kg NPK/ ha +20 t/ha FYM). However, minimum storage losses (1.20 %) were observed in treatment T_5 (T_1+Soil application of Phule micronutrient mixture grade I @ 25 kg/ha). The rotting losses of bulbs are also influenced by higher temperature (30-35°C), polar diameter and neck thickness, which are negatively correlated with rotting losses.

At 60 days after storage, minimum rotting losses (1.44 %) were observed in the treatment T_5 (T_1+Soil application of Phule micronutrient mixture grade I @ 25 kg/ha) and maximum rotting losses observed in treatment T_1 (RDF. *i.e*. 100:50:50 kg NPK/ha +20 t/ha FYM) (2.84 %). Singh and Dhankar (1989), Dhankhar., 1991; Kumar *et al*. (2000), Jayathilake *et al*. (2003).

Total storage loss (%)

The periodical total losses of onion bulb in storage are presented in Table 1. At 30 and 60 days after storage total losses were statistically significantly influenced by various treatments. At 30 days after storage minimum total losses in storage (3.30 %) were recorded in treatment T_5 (T_1+Soil application of Phule micronutrient mixture grade I @ 25 kg/ha), while the maximum total losses were observed in treatment T_1 (Recommended dose of fertilizer *i.e*. 100:50:50 kg NPK/ha +20 t/ha FYM) (6.43 %).

At 60 days after storage minimum total losses (7.44 %) were observed in treatment T_5 (T_1+Soil application of Phule micronutrient mixture grade I @ 25 kg/ha), which is at par with T_9 (T_1 + Foliar application of Phule Micronutrient mixture Grade II @ 0.5% at 30 and 45 DAT) (7.66 %), while the maximum total losses were observed in treatment T_1 (Recommended dose of fertilizer *i.e*. 100:50:50 kg NPK/ha +20 t/ha FYM) (10.05 %). Besides nutritional factors the factors like cultural aspects, storage conditions, climatic factors mainly temperature and humidity, physio-chemical characteristics of bulbs and cultivars might be playing important role in influencing total losses in storage of onion. The cumulative effects of different micronutrient application system affect the storage qualities of onion Singh and Singh *et al*. (1997), Kadam (2012), Surve *et al*., 2021).

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Conflict of interest

The authors declare no conflict of interest.

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