EFFECT OF POTASH ON YIELD AND QUALITY OF ONION (*ALLIUM CEPA L.*)

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ABSTRACT

An on-farm trial was conducted in different plots of various villages of Nalanda district to assess the effect of application of potash and spray of N: P:K (18:18:18) on yield, quality and bolting of onion. Farmers were previously applying DAP @ 110 Kg/ha and urea 80 Kg/ha. By application of MOP @ 100Kg/ha along with DAP @ 110 Kg/ha and urea 80kg/ha gives higher yield and better quality bulb as compared to produce that are getting in control. Although spraying of N: P:K (18:18:18) also increased the yield and quality significantly.

KEYWORDS: *Onion, Bulb Weight, Potash Fertilizer, Bolting Percentage & Yield*

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INTRODUCTION

The onion has a botanical name of *Allium cepa L.* and belongs to family Amaryllidaceae. It is the most important cultivated bulb crop of the genus *Allium*. Onion has primary centre of origin at central Asia with secondary centre of origin lies near east and Mediterranean region. From these places, the onion has spread widely to other many countries of the world (Astley D. Innes NL, Van der Meer QP., 1982). It is one of the important condiments among other bulb crops that is used as vegetable and also consumed as raw in most parts of the world. The green leaves can also used in preparation of vegetables and raw consumption. Onions are used for flavouring of soups, sauces and food due to its high nutritional value and medicinal properties to the human being (Randle WM, Ketter CA., 1998). The important oil present in onion is allyl-propyl disulphide as it leads to pungency in it. The onion bulbs is rich source of vitamins like vitamin c, biotin, quercetin, essential nutrients, antioxidants and 89% water also (Koca *et al.*, 2015; Insani *et al.*, 2016; Lisanti *et al.*, 2016). The rich amount phosphorus, carbohydrates and calcium are also found in onion bulbs. In area and production, India ranks second with production of 16.8 million tons (Anonymous, 2014) with area of 1.05 million hectares after China. Onion is cultivated in large scale in the major states in India such as Bihar, Rajasthan, Haryana, Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Andhra Pradesh, West Bengal, Chhattisgarh, Uttar Pradesh, Odisha, Tamilnadu, Jharkhand and Telangana. These states contribute 97% of total production of onion in the country. The production of rabi onion contributes major share with 136 lakh tones and in kharif season, 73 lakh tones during 2015-16. In the same financial year, the production of onion in Bihar was 1247.34 thousand metric tons which shares 5.96% of total production. (Source: State Department of Horticulture and Agriculture). The area of onion in Nalanda district was 5.99 thousand hectare and production was 164.37 thousand tones during financial year 2013-14. (Source: Department of Agriculture, Government of Bihar).

The fertilizer requirement of onion is high. The yield of produce 41 tonn/hect consume 102kg N, 41 kg P₂O₅ and 112kg K₂O/ha from soil (Halliday and Trenkel, 1992). Potassium plays very important role in plant

development and many physiological processes like translocation of photosynthates, control of ionic balance, transpiration and opening and closing of stomata photosynthesis, plant enzymes activation and various other processes (Thompson, B. 2010). Fertilizer and mineral nutrition affects yield and quality throughout the world (Chung B., 1989). For quality onion produce, we must follow some practices like soil moisture, fertilizers, disease control, harvesting at proper time for getting best result (Kabir A., 2007). The application of well balanced fertilizers is essential requirement for getting quality produce (Murashkina M et al., 2006). The quality plays an important role in onion for export and storage. The total export of onion from our country was 24.16 lakh MT (Source: APEDA). For better plant metabolism, potassium plays a lead role for developing resistance against pests and diseases, activation of plant catalysts, translocation of photosynthates, and regulation of plant pores. Potassium also improves many parameters like shining, colour, keeping quality and dry matter accumulation of many crops including onion (Subhani et al., 1990).

MATERIALS AND METHODS

This on-farm trial was conducted in village Birampur east of Krishi Vigyan Kendra, Harnaut in Nalanda district. Nalanda district occupies an area of 2355 square kilometers. The number of rivers flow through Nalanda districts like Phalgu, Jirayan, Kumbhori and Mohane. Most part of the land in the district is fertile land due to Indo gangetic plane. The district is rich in biodiversity and natural resources like hills of Rajgir is situated in extreme south with one small hillock in the district headquarters (Bihar sharif) of the district. During 1978, Rajgir wildlife sanctuary natural home was situated in Nalanda district with the area of 35 km².

Harnaut is one major block among 20 blocks of Nalanda district. It is situated at 49m (161ft) above mean sea level (MSL). It is one important block of Nalanda district. It is the entry point in Nalanda district from Patna district. It is located at 55 km from the capital of Bihar state. The distance of Nalanda ruins and buddist city Rajgir is around 23 to 32 km. The most of the soil in Harnaut is alluvial deposited by nearby rivers of the area. It is located on the river bank of the Panchanan River of the district. So, many local rivers passes nearby such as Panchanan, Dhoba, etc. The distance of Holy River Ganga is around 10km passes from Bhaktiarpur situated in the Patna district.

This trail was conducted during 2017-18 for increasing the yield and improves the quality of onion by reducing the bolting percentage in rabi crop. This trail was conducted on eight farmers plot with three replications in RBD design. The soil was analysed in soil testing laboratory at krishi vigyan Kendra, Nalanda. The PH of soil varies from 7.2 to 7.36; EC of soil varies from 0.021 to 0.028 ds/meter, organic carbon 0.49 to 0.586, available nitrogen varies from 225kg/hect to 264 kg/hect, available P₂O₅ 26.32 to 34.15 kg/hect and available K₂O 129 to 164 kg/hect. The basic nutrient status of soil of farmer's field is mentioned in table 1.

SOIL PROPERTIES OF THE DISTRICT

Nalanda district have various types of soils mainly deposited from alluvial deposit of southern Ganga plain. The major four types of soils are found in the district like clay loam, fine loam, loam and coarse loam. The nutrient status of soil in various blocks of the district is PH value of soil varies from 6.54 to 8.13, Organic carbon from 0.35 to 0.65, EC from 0.047 to 7.5, available nitrogen from 190.5 to 275.5, available phosphorus from 21.5 to 55, available potash from 148.5 to 236.5 as per data mentioned in table 3.

RESULTS AND DISCUSSIONS

The various parameters studied like bulb weight, affected bolting plant percentage, yield for judging the quality and production of onion bulb.

The application of potash is most effective in the growth of plants height significantly in onion with a dose of 125 potash per hectare (Hariyappa ., 2003). Similar result was also found in case of sweet pepper, egg plant, tomato and muskmelon with the increased application of potassium fertilization for increase in vegetative growth (Al- Karaki . 2000, El- Bassiouny AM., 2006, Fawzy ZF et al ., 2005, Gupta and SS Sengar ., 2000, Nanadal et al ., 1998, Nassar et al ., 2001).

Bulb weight: - The application of potash and spray of 1% solution of N:P: K (18:18:18) was showing significant result. The maximum mean bulb weight of 46.73 gm was reported in TO-3, as shown in table 2. Similar findings was also found in case of the adequate amount of supply of potash affects the yield and quality of onion (Behairy *et al.*, 2015; Diaz-Perez *et al.*, 2016; Garg *et al.*., 2018). An average bulb weight increases with an increase in potash level in onion, as reported by Ghaffor *et al* (2003). Potato also is a heavy feeder of potash. Its average requirement for 13.6 Mg of potato crop is 113 kg for vines and tubers and around 66% consumed by tubers and 34% by vines (Dahnke and Nelson, 1993; Rosen, 1993). The quantity of potash required for potato plant directly varied to tuber yield as per findings of Roberts and Beaton, 1988. Insufficient application of potash leads to reduction in tuber sizes and lesser yield as per McDole *et al.*, 1978. On such type of soils where potassium is fast acting the tuber yield is highly affected with the application of potassium reported by many researchers (McDole *et al.*, 1978; Sharma and Arora, 1987; Chapman *et al.*, 1992; Tindall and Westermann, 1994).

Affected bolting plant percentage:- The application of potash @ 100kg MOP/ha reduced the mean bolting percentage from 5.46 to 1.39 %. The spray of 1% solution of N:P:K (18:18:18) further reduced the bolting from 1.39% to 1.03 % (Table-2). The application of potash fertilizer along with phosphorus and nitrogen leads to better quality and higher yield in onion as per findings of Singh and Mohanty, 1998.

The yield of onion also increased significantly by potash application and by spray of 1% solution of N:P:K (18:18:18) due to reduction in bolting percentage. The increase in yield in case of potato was also recorded by Singh and Lal in 2012. Potassium fertilizer plays a significant role in yield with an increase of potato as per findings of El-Gamal, A. 1985. Same findings were also reported as greater yield increase by using K_2SO_4 by Bester, 1987; Tindall and Westermann, 1994 ;Wilcox, 1961. As per findings of Madan and Sandhu, the maximum bulb yield is of onion cv. Punjab 48 was reported with the application of 185:117:105 kg N, P_2O_5 AND K_2O per hectare. The increased plant growth (61.62, 64.9 cm), increase in yield and dry matter of bulbs was reported with application of K alone and application of zinc along with potash (100kg K_2O and 25 kg $ZnSO_4$) as per Singh and Dankhar (1991). The increase in dry matter, bulb size and bulb yield with the comparative increase in dose of potash from 0 to 150 kg per hectare, as per findings of Salimath (1990). The yield of garlic bulb also Increased (97.24 q per hectare) by application of N, P_2O_5 and K_2O (150:80:50) kg per hectare. Similar findings were noticed that the increase in yield and fresh weight of bulbs as 24.7 ton per hectare and 49.53g per bulb with application of 150 kg of K_2O per hectare as compared to other dose of potassium levels (Yadav et al ., 2002).

There are noticeable variation among the onion plant height as per different doses of fertilizer application as per findings of Nandi et al ., 2002. The highest plant height was obtained with the application of 90 kg N and 120 kg K_2O per hectare. Similar result was found with an increase in potassium doses varied from 100 to 150 kg per hectare. The increase

in number of leaves per plant (11.56, 11.68), weight of bulb (50.42 from 51.83 g) and bulb yield (226.66 from 227.66 q/ha) by increase in different doses of potash as per findings of Vachhani and Patel (1993). The dry weight of tops and bulbs, bulb diameter, 100 bulb weight and bulb yield up to 40 kg K₂O per hectare increase significantly with an increase in potassium application as per Kumar et al., 2001. The application of recommended dose of fertilizers and 150% of recommended dose of fertilizer (125 kg N, 33kg P₂O₅ and 50 kg K₂O per hectare) and (187 kg N, 49 kg P₂O₅ and 75 kg K₂O per hectare) leads to 42 and 56 % increase in bulb yield of onion as compared to 50 % dose of NPK as per Sharma et al., 2002. Similar finding was recorded by Yadav et al (2002) the increase in yield of bulb (247.79 q per hectare) and fresh weight of bulbs (49.53 g) by application of 150 kg K₂O per hectare as compared to other potassium doses. By (Tiwari and Agawam., 2003) on economic base the balanced dose of N, P₂O₅ and K₂O fertilizers (100:40:50) at proper time gave optimum returns .

The different quality parameters like specific gravity, dry matter, starch contents, vitamin –c and ash content varied with different doses of application of P and K (Khan *et al.*, 2012).

CONCLUSIONS

Application of MOP 100kg/ha along with DAP @ 110kg/ha, urea 80kg/ha and spray of NPK (18:18:18) @ 5kg/ha reduced the bolting percentage up to 1.03%, improved the quality and increase the yield of onion up to 76.66 quintal per hectare.

REFERENCES

1. Al-Karaki. Growth, sodium and potassium uptake and translocation in salt stressed tomato. *J Plant Nutrition*. 2002;23(3):369-379.
2. Anonymous (2014). National horticulture board, (<http://nhb.gov.in/area%production.html>) .
3. Astley D. Innes NL, Van der Meer QP. Genetic resources of *Allium* species: A global report. International board for plant genetic resources, Rome. 1982.
4. Behairy, A.G., A.R.Mahmoud, M.R.Shafeek, A.H.Ali, and M.M.Hafez. 2015. Growth, yield and bulb quality of onion plants (*Allium cepa* L.) as affected by foliar and soil application of potassium. *Middle east journal of agriculture research* 4(1):60-66.
5. Bester, G.G. 1987. Influence of the type of potassium fertilizer on potatoes (*Solanum tuberosum* L.). M.S.Thesis. Univ of Stellenbosch.
6. Chapman, K.S.R., LA. Sparrow, P.R.Hardman, D.N.Wright, and J.R.A.Thorp 1992. Potassium nutrition of Kennebec and Russet Burbank potatoes in Tasmania : Effect of soil and fertilizer potassium on yield, petiole and tuber potassium concentrations, and tuber quality. *Australian J Exp Agric* 32:521-527.
7. Chung B. Irrigation and bulb onion quality. *Acta horticulture*. 1989., 247:233-237.
8. Dahnke, W.C. and D.C.Nelson 1993. *Soils and fertilizers*. Pp 29-34.
9. Diaz- Perez, J.C., J.Bautista, A.Bateman, G. Gunawati, and C.Riner. 2016. Sweet onion (*Allium cepa*) plant growth and bulb yield and quality as affected by potassium and sulphur fertilization rates. *Hort.sci*. 51(12):1592-1595.
10. El-Bassiouny AM. Effect of potassium fertilization on growth, yield and quality of onion plants. *Journal of applied science research*. 2006;2(10):780-785.

11. El-Gamal, A. (1985). Effect of potassium level on potato yield and quality. *Journal of agriculture science Mansoura university.*, 10, 1473-1476.
12. Fawzy ZF, Behairy AG, Shehata SA. Effect of potassium fertilizer on growth and yield of sweet pepper plants (*Capsicum annuum*, L.). *Egypt J. Agri.Res.*2005;2(2):599-610.
13. Garg,R., S.S.Singh,M.Jadia, J. Barirwa, V.K.Tiwari, and R.S.yadav.2018. Interaction effect of sulphur and potash on growth,bulb yield and nutritional values of onion (*Allium cepa L.*). *Journal of pharmacognosy and phytochemistry* 7(2):746-748.
14. Ghaffoor, A.M; Jilani,S., Khaliq, G. and Waseem, K.(2003). Effect of different NPK level s on the growth and yield of three onion (*Allium cepa L.*) varieties.*Asian journal of plant science*,2 (3):342-346.
15. Gupta CR, SS Sengar. Response of tomato (*Lycopersicon esculentum* Mill.) to nitrogen and potassium fertilization in acidic soil of Bastar. *Veg. Sci.*2000;27(1):94-95.
16. Halliday,D.J. and M.E.Trenkel,1992. IFA world fertilizer use manual, International fertilikzer industry association, Paris, France, PP: 315-317.
17. Hariyappa N. Effect of potassium and sulphur on growth, yield and quality parameters of onion (*Allium cepa L.*). M.Sc. (Agri)
18. Insani, E.M., P.F.Cavagnaro, .M.Salomon, L.Langman, M.Sance, A.A.Pazos, F.O.Carrari, O.Filippini, L.Vignera, and C.R.Galmarini. 2016. Variation for health – enhancing compounds and traits in onion (*Allium cepa L.*) germplasm. *Food and nutrition sciences* 7: 577-591.
19. Kabir A. Rising onion prices. Dawn internet edition.,2007.
20. Khan, M. Z., Akhtar, M. E., Mahmood-ul-Hassan, M., Mahmood, M. M., and Safdar, M.N. (2012). Potato tuber yield and quality as affected by rates and sources of potassium fertilizer. *Journal of plant nutrition* ., 35(5), 664-677.
21. Koca,I., B.Tekguler, and H.I.Odabas 2015. Comparison of the antioxidant properties of some onion and garlic cultivars grown in Turkey. In: VII international symposium on edible Alliaceae 1143 (P.207-214).
22. Krishnamoorthy, C., K. Soorianathasundaram, and S. Mekala. "Effect of fertigation on FUE, quality and economics of cultivation in turmeric (*Curcuma longa L.*) cv. BSR 2." *Int. J. Agric. Sci. Res* 5.1 (2015): 67-72.
23. Kumar A, Ranbir Singh, Chhillar RK. Influence of nitrogen and potassium application on growth, yield and nutrient uptake by onion (*Allium cepa L.*). *Indian J. Agron.*, 2001;46(4):742-746.
24. Kumanan, M., et al. "Extraction of potash from K-Feldspar mineral by acid and molten salt leaching processes." *IASET Int. J. Metall. Mater. Chem. Eng* 7 (2016): 1-10.
25. Lisanti, A., V.Formica, F. Ianni, B. Albertini, M. Marinozzi, R. Sardella, and B.Natslini. 2016. Antioxidant activity of phenolic extracts from different cultivars of Italian onion (*Allium cepa*) and relative human immune cell proliferative induction. *Pharmaceutical biology* 54(5): 799-806.
26. Madan MR, Sandhu N. Economic analysis of nitrogen, phosphorus and potassium fertilization in onion. *Haryana J Hort Sci.*, 1983;12:221-223.
27. Murashkina M, Southard RJ, Pettygrove GS. Potassium fixation in silt, sand and clay fractions of soils derived from granitic alluvium of the San Joaquin valley, California. 18th world congress of soil science (july 9-15,2006) at Philadelphia, Pennsylvania, USA. 2006.

28. Nanadal JK, Ramesh- Vasist, Pandey UC. Effect of phosphorus and potassium on growth,yield and quality of tomato. *J. Potassium Research*. 1998; 14 (1/4):44-49.
29. Nandi RK, Deb M, Maity TK. Response of onion to different levels of irrigation and fertilizer. *Crop research*.2002;23(2):317-320.
30. Nassar HH, Barakat MA, El-Masry TA. Effect of potassium fertilization and paclobutrazol foliar application on vegetative growth and chemical composition of sweet pepper.Egypt *J.of Horticulture*. 2001;28(1):113-129.
31. Patel, JISNU K., K. S. Jadav, and H. C. Parmar. "An analysis of resource use efficiency of drip and conventional chilli farm in middle Gujarat." *International Journal of Humanities and Social Sciences*, 3 (3), 85 91 (2014).
32. Randle WM, Ketter CA. Pungency assessment in onions. *Proceedings of the 19 workshop conference of the association for biology laboratory education (ABLE)*.1998:177-196.
33. Salimath, SS. Studies on status of potassium and sulphur in soils and their effect on onion (*Allium cepa* L.). M.Sc.(Agri) Thesis, University of agricultural sciences, Dharwad. 1990.
34. Sharma RP, Dati N, Sharma PK. Combined application of N,P,K and FYM in onion (*Allium cepa* L.) under hills, dry temperature conditions of north western Himalayas. *Indian J Agric Sci*.2002;3(1):258-260.
35. SHARMA, VIJAY, A. Khan, and R. K. Shukla. "Growth and yield attribute of okra (*Abelmoschus esculentus* L.) under the application of bio and chemical fertilizers either alone or in combination." *International Journal of Agricultural Science and Research (IJASR)*, 1 (6), 189 198 (2016).
36. Singh J, Dankhar BS. Effect of nitrogen,potash and zinc on storage loss of onion bulbs (*Allium cepa* L.). *Vegetable science*.1991.18:16-23.
37. Singh, S., and Lal,S. (2012). Effect of potassium nutrition on potato yield, quality and nutrition use efficiency under varied levels of nitrogen application. 39(2), 155-165.
38. Subhani, P.M., Ravishankar, C. and Narayan, N. (1990). Effect of graded level and time of application of N and K₂O on flowering, fruiting and yield in irrigated chilli. *Indian cocoa, arecanut and spices*, 14: 70-73.
39. Tindall, T. and D.T. Westermann.1994. Potassium fertility management of potatoes.
40. Tiwari RS, Agarwal A. Infuence of N,P,K levels on yield of garlic (*Allium sativum* L.). *J.Pot.Res*.2003; 19:119-123.
41. Thompson, B. (2010). *Efficient fertilizer use-potassium (1st edition ed)*. New York: John willy and sons.
42. Vachhani MU, Patel ZG. Effect of nitrogen, phosphorus and potash on bulb yield and quality of onion (*Allium cepa* L.). *Indian journal of agronomy*.,1993;38:333-334.
43. Yadav RL, Sen NL, Fageria MS. Effect of nitrogen and potassium fertilization on quality bulb production of onion. *Haryana J. Hort. Sc.*,2002;31(3&4):297-298.
44. Wilcox, G.E. 1961. Effect of sulfate and chloride sources and rates of potassium on potato growth and tuber quality. *Am Potato J* 38: 215-220.

Table 1: Soil Status of Various Farmers Field Where on Farm Trail was Conducted

Soil Para-Meters Replications	PH	EC (ds/Meter)	Organic Carbon (%)	Available Nitrogen (kg/ha)	Available P ₂ O ₅ (kg/ha)	Available K ₂ O (kg/ha)
R1	7.21	0.020	0.562	256	31.56	156
R2	7.28	0.026	0.497	244	26.32	129
R3	7.34	0.024	0.573	258	32.36	162
R4	7.26	0.021	0.514	231	28.55	136
R5	7.32	0.025	0.499	225	26.85	132
R6	7.30	0.028	0.546	239	30.65	156
R7	7.36	0.023	0.538	228	29.65	154
R8	7.29	0.027	0.586	264	34.15	164

(NOTE : R1 to R8 are farmers plot used for On –Farm trail)

Table2: Effect of Potash on Yield and Quality of Different Parameters Studied

Parameters Treatments	Bulb Wt. (gm)	Affected Bolting Plant %	Yield Q/Acre
TO1 Farmers practice (DAP @ 110kg/ha and Urea 80 kg/ha)	39.30	5.46	67.91
TO2 (Farmers practice and 100 kg MOP/ha)	44.67	1.39	73.43
TO3 (TO2 and spray of 1% solution of NPK 18:18:18)	46.73	1.03	76.66
SEm ±	1.08	0.66	1.33
Cv	5.546	56.67	4.10
CD	2.317	1.42	2.86

Table: 3: Availability of Organic Carbon and Different Nutrient Status in the Soils of Nalanda District

Sl. No.	Name of the Block	No. of Soil Samples Analysed	OC %	PH	EC MS/CM	Available N	Available P	Available K
1	Bihar sharif	133	0.59	6.78	0.498	250.5	31	199.5
2	Asthawa	114	0.47	6.54	1.235	190.5	24	177
3	Bind	51	0.57	7.31	.710	241	35	180
4	Harnaut	98	0.47	7.01	0.047	210	31	164
5	Sarmera	57	0.65	6.58	0.216	275.5	30	236.5
6	Noorsarai	119	0.51	6.99	0.429	212	30	156.5
7	Rahui	100	0.60	6.70	0.474	256	30	169
8	Rajgir	91	0.35	7.73	0.315	223	25	195.5
9	Silao	88	0.59	7.15	0.075	244	27	199.5
10	Ben	65	0.46	7.67	0.122	195	28	184
11	Giriyak	86	0.48	6.96	0.502	203	37	148.5
12	Katrisarai	28	0.55	8.13	6.010	240.5	55	230
13	Hilsa	109	0.55	6.91	0.499	236	26	196
14	Karai parsurai	90	0.48	6.85	3.279	205	29.5	177.5
15	Chandi	131	0.47	6.64	0.480	201.5	21.5	155.5
16	Tharthari	50	0.50	7.13	0.442	227.5	34.5	213
17	Nagarnausa	88	0.57	6.58	7.500	240	29.5	179
18	Ekangar sarai	173	0.55	6.94	0.445	225	32	180
19	Parwalpur	46	0.46	7.50	0.080	193	27	225
20	Islampur	151	0.53	7.24	0.318	225	31	212

SOURCE: ATMA, Nalanda