RESEARCH ARTICLE

INFLUENCED OF NUTRIENTS AND PLANT GROWTH REGULATORS ON ECONOMIC OF ONION (*ALLIUM CEPA* L.)

Priynka Kumari Jat[1]*, S.K. Khandelwal[2] and Murari Lal Chopra[3]

[1,]*Rajasthan Agricultural Research Institute, Durgapura Jaipur*
[2, 3]*S.K.N. College of Agriculture, S.K.N. Agriculture University, Jaipur, Rajasthan-302018, India*
Email: priyankadhaka100@gmail.com

Received-07.09.2020, Revised-28.09.2020

Abstract: The field experiment was conducted to study the "Effect of Nutrients and Plant Growth Regulators on Growth, Yield, Quality and Storage Life of Onion (*Allium cepa* L.)" in loamy sand soils of the Research Farm, Rajasthan Agricultural Research Institute Durgapura (Jaipur, Rajasthan) during *rabi* season 2016-17 and 2017-18. The experiment consisted four nutrient combination (NP, NPK, NPKS and NPKSB) and four treatment were nutrient and plant growth regulators (Control, $CaCl_2$ @ 0.5%, ethephon @ 3000 ppm and mepiquat chloride @ 750 ppm) under three curing methods (Field curing, curing under 60% shade and curing under poly tunnel) thereby making forty-eight treatment combinations tested in factorial randomized block design with three replications. Results indicated that economics of maximum net returns Rs 475439.31 /ha and Rs 466819.98 were recorded with combined application of NPKSB, mepiquat chloride along with field curing and NPKSB, mepiquat chloride along with 60% shade net curing during 2016-17 and 2017-18 respectively. Maximum B: C ratio 6.11 and 6.01 was recorded with combined application of NPKSB, mepiquat chloride along with 60% shade net curing during 2016-17 and 2017-18 respectively.

Keywords: B: C ratio, Net returns, Nutrients onion, Plant growth regulators

INTRODUCTION

Onion (*Allium cepa* L) is a bulb vegetable, cultivated in almost all the countries of the world and consumed across the globe. Onions are often chopped and used as an ingredient in various healthy warm dishes. Onions are said to be have therapeutic, antibacterial and antifungal beneficial properties. Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops cultivated extensively in India and it belongs to family *Alliaceae*. Onion is an indispensable item in every kitchen as vegetable and condiment, therefore commands, an extensive internal market. Onion is liked for its flavour and pungency which is due to the presence of a volatile oil '*allyl propyl disulphide*'- organic compound rich in sulphur. Onion is used in pharmaceutical preparations due to its medicinal values. Onion is also known to cure heart diseases as it checks the deposition of cholesterol in blood vessels.

Availability of nitrogen is important for growing plants as it is major indispensable constituent of protein and nucleic acid. Being a part of plant hormones, it is involved in regulating plant growth and developmental processes. Similarly, Phosphorus is indispensable constituent of nucleic acids, phospholipids and several enzymes. It is also needed for the transfer of energy within the plant system and is involved in its various metabolic activities (Yalwalker *et al*., 1962). Potassium imparts vigour and disease resistance to the plant and plays an important role in crop productivity. The essential role of K in numerous physiological and biochemical processes in the plants including photosynthesis, enhancing the translocation of assimilates, protein synthesis, maintenance of water balance, and promoting enzyme activities are well established (Marschner, 2012). Likewise, sulphur is an essential constituent of certain amino acids namely cysteine and methionine and involved in synthesis of proteins and sulphur bearing vitamins like biotine, thiamine and some co-enzymes. Sulphur is a constituent of "Allyl propyl disulphide" which imparts the pungency in onion.

Boron is essential for normal transport of water, nutrients and photosynthetic sugars to rapidly developing meristemetic tissues, such as root tips, leaves, buds and storage tissues. Application of boron can increase bulb size and yield of onion (Smriti *et al*., 2002). Boron deficiency affects reproductive growth more than vegetative growth. Calcium application maintains cell turgor, membrane integrity, tissue firmness and delays membrane lipid catabolism thus, extending storage life (Chaplin and Scott, 1980).

Mepiquat chloride induce extension in storage life of onion might be due to anti-gibberellin action, which might have facilitated the maintenance of quality of bulbs in storage (Rahman and Isenberg, 1974). Ethrel played an important and pivotal role in increasing the bulb yield as it accelerated bulb enlargement and the photoperiodic phenomenon that induced synthesis, translocation and accumulation of assimilates resulting in increasing the bulb size. Inhibition of potato sprouting by continuous application of ethylene has long been known (Rylski *et al*., 1974) and has found commercial application (Prange *et al*.,

*Corresponding Author

1998). Curing is the most important operation in the post-harvest processing of onion to be followed immediately after harvesting. Curing can be defined as removing the excess moisture from the outer layers of the bulb prior to storage (Maw *et al.*, 2004)

MATERIALS AND METHODS

The experiment was conducted at the Research Farm, Rajasthan Agricultural Research Institute, Durgapura, Jaipur (Rajasthan). The region falls under Agro-Climatic Zone III- A (Semi-Arid Eastern Plain). Durgapura is situated at 26.5º North latitude, 75.47º East longitude and an altitude of 390 meters above Mean Sea Level in Jaipur district of Rajasthan. The initial soil fertility status of experimental plot was well drained clay loam with pH 8.00 and EC 0.80 ds m^{-1}. The available N, P, K and S content of the soil were 248.11, 11.14, 168.41 and 13.10 kg/ha, respectively. The experiment was laid out in Factorial Randomized Block Design with three replications and consisting of Forty-eight treatments combination. The onion cultivar RO-59 was sown in nursery beds during November and transplanted in January with space of 15x10 cm between rows and plants, respectively. All nutrients like NP@ 100:50 kg/ha, NPK @100:50:150 kg/ha, NPKS@100:50:150:45 kg/ha and NPKSB@ 100:50:150:45:1kg/ha and nutrients and plant growth regulators *viz* like control, $CaCl_2$@0.5%, ethephon@3000 ppm and mepiquat chloride@750 ppm and curing methods *viz* field curing, curing under 60% shade and poly tunnel curing. Fertilizers were applied as per treatment through Urea, DAP and MOP at the time of sowing as basal dose and split application of urea at top dressing. The 6-10 days interval irrigations was applied during growing season. Intercultural operations *viz.*, thinning, hoeing and weeding were followed after 20 days of sowing to maintain recommended spacing and weed control. Two hand weeding during growing period and harvest maturing in 50 to 55 days after sowing and observations on tagged plants were recorded

Economics

1. Gross Income (Rs) = Total crop production x Value of the product (both main and by product)
2. Total cost = Common cost + Treatment cost
3. Net return (Rs/ha) Net return (Rs/ha) of individual treatment was calculated by deduction of cost of cultivation from the gross return of particular treatment

Net return = Gross Return – Total Cost of Cultivation.

RESULTS AND DISCUSSION

The data on economic attributes parameters as well as soil fertility status after harvest the crop as influenced by combined application of nutrients, plant growth regulators and curing methods of the different treatments are presented in Table 1 and 2.

Table 1. Common cost of cultivation for one hectare of the experiment

S. No	Particulars	Unit	Rate/unit (Rs)	Cost (Rs/ha)
(A)	Land preparation charges by tractor (4 ploughing and one planking)	12hrs	370	4440
(B)	Field preparation			
	Bed preparation	20 labour	245	4900
	Planting of seedling	33 labour	245	8085
	Irrigation	17 labour	245	4165
	Weeding and hoeing	16 labour	245	3920
	Spraying of fungicides/ insecticides/Pant growth regulators	6 labour	245	1470
	Spraying of Pant growth regulators	8 labour	245	1960
	Fertilizers and manuring application	7 labour	245	1715
	Harvesting /preparation of produce	30 labour	245	7350
	Miscellaneous			1000
	Total			34565
(c)	Material inputs			
	Seed material	10kg/ha	1600	16000

	Plant protection			3000
	Electricity charges			2000
	Total			22000
(D)	Overhead cost			
	Rentel value of land			4711
	Interest of working capital			3974
	Depreciation cost			1000
	Total			9685
(E)	Storage work			
	Curing	18 labour	245	4410
	Storage	20 labour	245	4900
	Total			9310

General cost of cultivation = I(A) + I(B) + I(C) + (D)+ (E)=80000/-

Benefit: Cost ratio

In order to find out net benefit: cost ratio, the net return from individual treatments was divided by their respective cost of cultivation, which included cost of treatment also. B:C Ratio = Net return/ Total Cost of Cultivation In order to evaluate the effect of different treatments on vegetative growth and yield characters, the data were statistically analyzed as per.

Net Returns

Interactive effect between nutrients, plant growth regulator and curing method ware found to be significant with respect to net returns (Table 2). Results indicated that economics of maximum net returns Rs 475439.31/ha and Rs 466819.98/ha were recorded with combined application of NPKSB, mepiquat chloride along with field curing ($N_4G_4C_1$) and NPKSB, mepiquat chloride along with 60% shade net curing ($N_4G_4C_2$) during 2016-17 and 2017-18 respectively. Sayed *et al.,* (2012) reveals that combined application of mepiquat chloride @ 500 ppm with 96 kg K_2O/fed significantly increased total bulb yield (kg/plot and q/ha) and net returns in garlic crop. These results are in accordance of agreed with those of Das *et al*. (1996) and Dimov (2000) in garlic crop.

B: C Ratio

Interactive effect between nutrient, plant growth regulators along with curing methods had significant effect on B: C ratio (Table 2.). The maximum B: C ratio (6.11 & 6.01) was recorded with combined application of NPKSB, mepiquat chloride along with 60% shade net curing ($N_4G_4C_2$) during both of the year respectively. This treatment was significantly higher over other treatment combinations. However, application of NP, control along with poly tunnel curing methods gave minimum B: C ratio (3.25 & 3.05) during both of the year respectively. On the basis of the experiment as well as economic point of views, an application of nutrient, plant growth regulator along with curing method produced its significant impact on net returns and cost of benefits ratio. The treatments ($N_4G_4C_2$) were found economical, profitable and proved highly remunerative under the Durgapura (Rajasthan, India) conditions for growing the onion cv. 'RO 59.

Table 2. Comparative economics of various treatments of onion (2016&17-2017-18)

Treatment combinations (2016-17 & 17-18)	Common cost of cultivation (Rs/ha) (2016-17 & 17-18)	Treatment cost (Rs ha^{-1}) (2016-17 & 17-18)	Total cost of cultivation (Rs /ha) (2016-17 & 17-18)	Bulb yield (q/ha) 2016-17	Bulb yield (q/ha) 2017-18	Gross returns (Rs/ ha) 2016-17	Gross returns (Rs/ha) 2017-18	Net returns (Rs/ ha) 2016-17	Net returns (Rs/ha) 2017-18	B : C ratio 2016-17	B : C ratio 2017-18
$N_1G_1C_1$	80000	6719.70	86719.70	207.33	204.66	290262.00	286528.67	203542.30	199808.96	3.35	3.30
$N_1G_1C_2$	80000	6719.70	86719.70	214.98	214.76	300966.87	300663.02	214247.16	213943.32	3.47	3.47
$N_1G_1C_3$	80000	6719.70	86719.70	201.55	189.20	282165.15	264881.87	195445.44	178162.16	3.25	3.05
$N_1G_2C_1$	80000	6744.70	86744.70	205.93	210.95	288308.53	295327.20	201563.83	208582.50	3.32	3.40
$N_1G_2C_2$	80000	6744.70	86744.70	210.32	212.32	294446.13	297252.67	207701.43	210507.96	3.39	3.43
$N_1G_2C_3$	80000	6744.70	86744.70	218.62	213.26	306063.33	298564.00	219318.63	211819.30	3.53	3.44

$N_1G_3C_1$	80000	7844.70	87844.70	229.32	256.14	321048.00	358591.33	233203.30	270746.63	3.65	4.08
$N_1G_3C_2$	80000	7844.70	87844.70	262.82	262.32	367948.00	367243.33	280103.30	279398.63	4.19	4.18
$N_1G_3C_3$	80000	7844.70	87844.70	229.02	256.28	320625.67	358792.00	232780.96	270947.30	3.65	4.08
$N_1G_4C_1$	80000	6832.20	86832.20	250.11	253.43	350158.67	354806.67	263326.46	267974.46	4.03	4.09
$N_1G_4C_2$	80000	6832.20	86832.20	266.54	280.65	373160.67	392910.00	286328.46	306077.80	4.30	4.52
$N_1G_4C_3$	80000	6832.20	86832.20	248.14	260.22	347392.73	364301.47	260560.53	277469.26	4.00	4.20
$N_2G_1C_1$	80000	9839.70	89839.70	232.36	248.65	325308.67	348105.33	235468.96	258265.63	3.62	3.87
$N_2G_1C_2$	80000	9839.70	89839.70	247.21	267.77	346089.33	374882.67	256249.63	285042.96	3.85	4.17
$N_2G_1C_3$	80000	9839.70	89839.70	237.90	236.89	333060.00	331641.33	243220.30	241801.63	3.71	3.69
$N_2G_2C_1$	80000	9864.70	89864.70	244.52	271.88	342328.00	380632.00	252463.30	290767.30	3.81	4.24
$N_2G_2C_2$	80000	9864.70	89864.70	283.26	293.05	396568.67	410265.33	306703.96	320400.63	4.41	4.57
$N_2G_2C_3$	80000	9864.70	89864.70	273.04	284.45	382257.87	398225.33	292393.16	308360.63	4.25	4.43
$N_2G_3C_1$	80000	10964.70	90964.70	312.51	313.73	437509.33	439226.67	346544.63	348261.96	4.81	4.83
$N_2G_3C_2$	80000	10964.70	90964.70	319.25	338.47	446950.00	473853.33	355985.30	382888.63	4.91	5.21
$N_2G_3C_3$	80000	10964.70	90964.70	306.11	318.80	428549.33	446320.00	337584.63	355355.30	4.71	4.91
$N_2G_4C_1$	80000	9952.20	89952.20	318.92	330.00	446488.00	462000.00	356535.80	372047.80	4.96	5.14
$N_2G_4C_2$	80000	9952.20	89952.20	333.17	338.60	466433.33	474040.00	376481.13	384087.80	5.19	5.27
$N_2G_4C_3$	80000	9952.20	89952.20	314.73	328.57	440626.67	460002.67	350674.46	370050.46	4.90	5.11
$N_3G_1C_1$	80000	10062.68	90062.68	268.09	287.51	375330.67	402518.67	285267.99	312455.99	4.17	4.47
$N_3G_1C_2$	80000	10062.68	90062.68	295.80	311.47	414120.00	436053.33	324057.32	345990.66	4.60	4.84
$N_3G_1C_3$	80000	10062.68	90062.68	285.47	298.09	399653.33	417330.67	309590.66	327267.99	4.44	4.63
$N_3G_2C_1$	80000	10087.68	90087.68	287.27	300.93	402173.33	421306.67	312085.66	331218.99	4.46	4.68
$N_3G_2C_2$	80000	10087.68	90087.68	309.21	312.38	432896.80	437336.67	342809.12	347248.99	4.81	4.85
$N_3G_2C_3$	80000	10087.68	90087.68	324.44	316.07	454221.60	442493.33	364133.92	352405.66	5.04	4.91
$N_3G_3C_1$	80000	11187.68	91187.68	334.73	323.93	468626.67	453506.67	377438.99	362318.99	5.14	4.97
$N_3G_3C_2$	80000	11187.68	91187.68	342.93	357.52	480106.67	500528.00	388918.99	409340.32	5.27	5.49
$N_3G_3C_3$	80000	11187.68	91187.68	333.20	352.80	466480.00	493920.00	375292.32	402732.32	5.12	5.42
$N_3G_4C_1$	80000	10175.18	90175.18	341.53	352.77	478142.00	493873.33	387966.82	403698.16	5.30	5.48
$N_3G_4C_2$	80000	10175.18	90175.18	347.70	367.79	486777.20	514901.33	396602.02	424726.16	5.40	5.71
$N_3G_4C_3$	80000	10175.18	90175.18	334.67	350.07	468533.33	490102.67	378358.16	399927.49	5.20	5.44
$N_4G_1C_1$	80000	12880.86	92880.86	271.95	289.09	380734.67	404726.00	287853.81	311845.14	4.10	4.36
$N_4G_1C_2$	80000	12880.86	92880.86	260.38	292.92	364536.67	410083.33	271655.81	317202.48	3.92	4.42
$N_4G_1C_3$	80000	12880.86	92880.86	241.69	282.77	338370.67	395882.67	245489.81	303001.81	3.64	4.26
$N_4G_2C_1$	80000	12905.86	92905.86	345.61	332.98	483854.00	466176.67	390948.14	373270.81	5.21	5.02
$N_4G_2C_2$	80000	12905.86	92905.86	353.74	343.29	495236.00	480606.00	402330.14	387700.14	5.33	5.17
$N_4G_2C_3$	80000	12905.86	92905.86	322.53	324.12	451542.00	453763.33	358636.14	360857.48	4.86	4.88
$N_4G_3C_1$	80000	14005.86	94005.86	373.88	374.64	523432.00	524496.00	429426.14	430490.14	5.57	5.58
$N_4G_3C_2$	80000	14005.86	94005.86	374.57	381.51	524402.67	534118.67	430396.81	440112.81	5.58	5.68
$N_4G_3C_3$	80000	14005.86	94005.86	359.57	377.95	503402.67	529130.00	409396.81	435124.14	5.36	5.63
$N_4G_4C_1$	80000	12993.36	92993.36	392.75	399.87	549854.67	559813.33	456861.31	466819.98	5.91	6.02
$N_4G_4C_2$	80000	12993.36	92993.36	406.02	399.35	568432.67	559090.00	475439.31	466096.64	6.11	6.01
$N_4G_4C_3$	80000	12993.36	92993.36	387.06	389.70	541884.00	545575.33	448890.64	452581.98	5.83	5.87

Sale price of bulb = ₹ 14/kg, Urea= ₹ 6.2/kg, DAP = ₹24.40/ kg
MOP = ₹ 12.48/kg, Gypsum = ₹ 0.92/kg, Borax = ₹ 310/kg,
$CaCl_2$ = ₹10/kg, Ethephon = ₹ 750/L, Mepiquat Chloride = ₹ 300/L

ACKNOWLEDGEMENTS

The authors are grateful to Dean, Shri Karan Narendra Agriculture college, Head Department of Horticulture, Shri Karan Narendra Agricultural University, Jobner, Jaipur, Rajasthan for providing necessary facilities to carry out the investigations.

REFERENCES

Chaplin, G. R. and Scott, K. J. (1980). Association of calcium in chilling injury susceptibility of stored avocados. Horticulture Science, 15: 514- 515.

Das, A.K., Sadhu, M.K. and Som, M.G. (1996). Effect of foliar application of NAA, CCC and ethrel on growth and yield of garlic multiple and single clove. India Cocoa, Arecanut and Spices Journal, 20(2): 57-61.

Dimov, I. (2000). Ethylene in vegetable crop production current status and problems. Bulgarian Journal of Agricultural Science, 6(6): 669-674.

Marschner, P. (2012). Marschner's Mineral Nutrition of Higher Plants. Third Edition. Academic Press, Elsevier.

Maw, B.W., Mullinix, B.G., and Smittle. D.A. (2005). The influence of harvest maturity, curing and storage conditions upon the storability of sweet onions. Applied Engineering in Agriculture, 13:511-515.

Prange, R.K., Kalt, W., Daniels-Lake, B.J., Liew, C.L., Page, R.T. and Walsh, J.R. (1998). Using ethylene as a sprout control agent in stored 'Russet Burbank' potatoes. Journal of the American Society for Horticultural Science, 123:463–469

Rahman, A. M. and Isenberg, F.M.R. (1974). The role of exogenous plant regulators in the dormancy of onion bulbs. Journal of Agriculture Science, 82:113-116.

Rylski, I., Rappaport, L. and Pratt, H.K. (1974). Dual effects of ethylene on potato dormancy and sprout growth. Plant Physiology, 53: 658–662.

Sayed, H.E., Sayed, A.H. and El Morsy, A.H.A. 2012. Response of productivity and storability of garlic (*Allium sativum* L.) to some potassium levels and foliar spray with mepiquat chloride (PIX). International Research Journal of Agricultural Sciences and Soil Science, **2**(7): 298-305.

Smriti, S., Kumar, R. and Singh, S.K. (2002). Effect of sulphur and boron nutrition on growth, yield and quality of onion *(Allium cepa* L.). Journal of Applied Biology, 12: 40-46.

Yawalker, K.S., Agrwal, J.P. and Bokde, S. (1962). Manures and fertilizer- Agri- Horticultural Publishing House, Nagpur, 490010, India.