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Influence of K application on the yield and quality of Bottle Gourds (Lagenaria siceraria) in relation of K-forms and release characteristics in Alfisol soils of Eastern India

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Abstract
Application of K in soil at higher level showed significant enhancement in yield ,quality parameters of Bottle gouard and different forms of K. Highest value of total extractable K was found (2404 kg ha^{-1}) with the application of 200 % K as basal (T_4) while elimination of K from treatment (T_1) resulted in considerable decrease in step K from initial status of soil.High degree of correlation value of available K with exchangeable K (r= 0.98**) than with water soluble K (r= 0.78**) showed that soil exchangeable phase played more significant role in regulating the availability of K.

Key Word; *Soil, Potassium ,Fertilizer, Quality parameters, Yield and Correlation.*

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I. Introduction

One of the reasons for low productivity of vegetables is the improper fertilizer management besides low to medium soil fertility in the Eastern India (State of Jharkhand). Bottle gourds , which helps in maintaining a healthy heart and brings down bad cholesterol levels. The juice is also beneficial for diabetic patients as it stabilizes the blood sugar level and maintains blood pressure, are usually grown under no or highly reduced rate of fertilizer application on a marginal soils. However, there is a scope for increasing yield and quality(biochemical) of bottle gourd under proper fertilization with special reference to potassium (Jifon ***et al.,*** 2009 and Laster ***et al***. 2006) In addition to its major role in metabolic processes and fruit formation K improves the bio-chemical properties of vegetable produce, imparts resistance to pests and diseases and tolerance to cold and frost. Deficiency of K drastically changes the yield and quality along with negatively affecting the unsaturated / saturated fatty acids ratio (Brar ***et al.***, 2010).

In soil potassium (K) exists in several forms that, includes mineral K (90 to 98% of total K), non-exchangeable K, exchangeable K, and dissolved or solution K (K^+ ions), while plants can only directly take-up solution K (water soluble K) (Tisdale *et al.* 1985). Even though K is abundant in many soils, the bulk of soil K may be unavailable to plants, because of the fact that the pool of plant-available K is much smaller compared to the other forms of K. Uptake of potassium depends on numerous plant and environmental factors (Tisdale *et al.* 1985; Marschner 1995; Brady and Weil 1999). For instance, soil properties and adequate soil moisture supply is necessary to facilitate diffusion of K (which usually accounts for > 75% of K movement) to plant roots for uptake. Potassium uptake also depends on plant factors, including genetics and developmental stage (vegetative versus reproductive stages; Rengel *et al*. 2008). Knowledge regarding various forms of K in soil and an understanding of condition controlling its availability to growing crops are important for an appraisal of the available K in the soils. Many investigators reported that availability of K is determined by relative amount of the different forms in which it is present in the soil (Attoe and Thruogh 1946; Wiklander 1954). Sen *et al.* (1949) were the first to determine different forms of K in red and laterite soils from various part of India.

Several workers have studied the effect of potassium on yield of various crops in addition to the other nutrients. But, the information about the relationship among different fractions of potassium in acid soil as affected by different level of potassium application on vegetable crops is very limited in Alfisol of Jharkhand. The aim of present investigation was to work out the proper K fertilizer management for setting optimum growth, yield, nutrient uptake and bio-chemical properties of bottle gourd and also to work out the benefit cost ratio of the applied fertilizer under farmers field conditions of Jharkhand state.

II. Methods and Materials

Field experiments at farmers field were carried out at 4 location *viz*. Simar Tola (N- $23^0$17' E- $85^0$19'), Pithoria (N- $23^0$31.2' E- $85^0$17.9') and Ormanjhi (N- $23^0$27.8' E- $85^0$28.2') and Patratu (N-23^0 37.629' E-85^o17.372') of Ranchi district. (Jharkhand State) during 2011 to 2012. The experiments were laid out with seven treatments T_1 (0 % K), T_2(100% K, i.e. 40 kgK_2Oha^{-1}), T_3 (150% K, i.e. 60 kgK_2Oha^{-1}), T_4 (200% K, i.e. 80 kgK_2Oha^{-1}), T_5 (100% K,applied in two splits of ½ + ½), T_6 (150% K, applied in two splits of ½+½) and T_7 (200% K, applied in two splits of ½+½). Doses of Nitrogen (80 Kgha^{-1}), Phosphorus (40 Kg P_2O_5 ha^{-1}) and Potash (40 KgK_2Oha^{-1}) were applied as per state recommendation. DAP (Di-ammonium Phosphate), Urea and MOP (Murate of Potash) were the sources of N, P_2O_5 and K_2O respectively. Seeds of Bottle Gourd (variety-Victoria) were sown in the month of March directly . and fruits were harvested five times at each interval of 8 to 9 days. Yield data were recorded. Fruits samples were collected at the time of harvest and cut it in different pieces with peel. Fresh pieces were used for T.S.S (by using digital Refractometer), CHO (Anthrone method; Hedge ***et al***., 1962), phenol (using Folin-Ciocalteau reagents; Malick and Singh 1980) and crude fiber (Maynard, 1970). Rest other pieces were oven dried at 65^{o}C and ground in stainless steel Willey mill. Fruits samples were digested in di-acid (HNO_3: $HClO_4$: 10.4) for P and K and digested in H_2SO_4 + catalyst ($CuSO_4$ +K_2SO_4) for nitrogen concentration. The N, P and K contents were estimated by Kjeldhal, Vanado molybdate yellow colour methods and flame-photometer methods (Jackson, 1973), respectively.

A composite soil samples from the above mentioned areas were collected (0-15 cm) before sowing and after drying big clods were broken and soils were ground on a wooden plank with wooden roller leaving no aggregates. The soil was then passed through 2 mesh sieve. The post harvest soil samples (0-15 cm) were also collected from all the plots according to the method as described by Jackson (1967). Samples were analyzed for important physical and chemical properties.

The pH of soils were measured in 1:2.5 (soil: water) suspension with the help of glass electrode digital pH meter as described by Jackson (1973).Particle size of soils was estimated by Hydrometer method as described by Means and Parcher (1965) and then mechanical composition and textural class were determined by using USDA textural triangle .Organic carbon of the soils was estimated by Walkley and Black (1934) method. Available N is estimated by distilling soil with alkaline potassium permanganate method suggested by Subbiah and Asija (1956).The soil was extracted with Bray P_1 extractant (0.03 N NH_4F and 0.025 N HCl) solution and was estimated (Bray and Kurtz 1945) as described by Jackson (1973) on double beam spectrophotometer. Initial soil properties were described in Table 1.

Water soluble K was determined by flame photometer (ELICO CL 361) after extraction of soil with double distilled water (Hanway and Heidal 1952) in soil to solution ratio 1:5 (w/v).Available potassium was determined by flame photometer (ELICO CL 361) after extraction of soil with neutral normal ammonium acetate (Jackson 1973) in soil to solution ratio 1:5 (w/v).Exchangeable K was estimated by deducing the value of water soluble K from available K.The content of 1N HNO_3 K of soil was extracted by using 1N boiling HNO_3 extractant following of the soil: extractant ratio of 1:8. In the extract, 1 HNO_3 K was determined by Flame photometer as described by Wood and De Turk (1941).Non-exchangeable K was estimated by deducing the value of available K from 1N HNO_3extractable K.The procedure followed for the determination of constant rate K (Haylock described as constant rate K) as recommend by Haylock (1956) in which successive extractions of soil with boiling 1N HNO_3 (1:8 soil solution ratio) for 10 minutes were carried out to a stage where the release of K remained more or less constant.Step K was determined by adding the value obtained from subtracting the amount of constant rate K from the K released in each step of successive extraction following Haylock (1956) procedure as modified by McLean (1961).Cumulative K release/ Total extractable K was estimated by the addition of total K released during each extraction with hot 1N HNO_3.Lattice K was determined by subtracting the 1 N HNO_3 extractable K from total K.Total K 0.5 g of soil was weighed and kept in a platinum crucible and treated with 5 ml of HNO_3, 5 ml HF and 2.5 ml of $HClO_4$ followed by addition of 3-5 drops of H_2SO_4. It was digested and fumed to moist dryness. After cooling, 10 ml of conc. HCl was used to dissolve. The residue and finally 50 ml volume was made with double distilled water. Total K was then determined photometrically.

Available sulphur of soil was extracted by using 0.15 per cent $CaCl_2$ extractant in the soil: extract ratio 1:5 (Williams and Steinbergs 1959) sulphate sulphur was determined turbidimetrically (Chesnin and Yein 1951).

The statistical analysis was done by taking all the sites in a year as replicates. All the soils had quite a less variation in the physical as well as chemical soil characteristics. Thus, these soils were considered normal for the growth and development of bottle gourds.The data obtained from laboratory were analysed statistically by Fisher's method of analysis of variance. The value of critical difference at 5 % level of significance was computed as outlined by Panse and Sukhatme (1985). The correlation coefficients among different soil parameters were calculated as per method suggested by Snedecor and Cochran (1967). Final results were interpreted based on the statistical analysis of the parameters analysed for soil.

III. Results and Disscusion

Biometric characters

A significant difference among rates and timing of K application was observed in its effect on fruits, flowering and marketable yield. Application of K irrespective of the time and doze increased the yield over FFP. Maximum number of fruits and flowering were found with the application of 150% K (60 kg ha^{-1}) in two splits. It is due to the enhancement of K-fertilizer use efficiency.

A positive difference were observed in bio-chemical properties of bottle gourd like carbohydrate, phenol, TSS, crude fiber, Protein content and reducing and non -reducing sugar. (table -2). CHO content ranged from 3.14 to 4.68%, Phenol varied from 66.56 to 106.45 mg/100g, TSS from 2.53 to 3.13^{o} brix, crude fiber 2.5 to 3.2 %, protein 1.92 to 2.56 % (Bidari and Hebsur, 2011).

Yield

A significant difference was found in the fresh weight yield of bottle gourd due to the application of potassium at different rate and time (table- 3). In absence of K application (FFP) the yield of bottle gourd decreased drastically. This may be ascribed to the reasons that in the absence of K relatively less number of fruit were set due to less number of female flowers and imbalance ratio of male and female flowers (Patil ***et al***.,1996). The developed fruits also did not attain full size and weight with the result most of the fruits remained unmarketable. The mean value of yield varied from 9.16 to 18.75 t/ha. The difference caused in the total yield due to K application at different rates and times owed to increase in the proper growth and weight. These results are in agreement with the findings of Nanadal ***et al***. (1998), Ali S.M. ***et al***.(1999) Ravi kumar (2001) .

Nutrient Concentration

Nitrogen and phosphorous concentration of bottle gourd varied from 0.31 to 0.41% and 0.18 to 0.25% respectively. Maximum N and P concentrations were recorded in FFP treatments. It may be attributed that due to the lower yield, plants consequently absorbed more amount of N & P nutrients in the fruits. The concentration of potassium in the bottle gourd varied from 1.11 to 2.59% Madhu ***et al***.(2004) and was higher under application of K (Fig.1).

The application of potassium to the bottle gourd was highly economical. The value cost ratio with application of 40 kg and 60 kg K_2O ha^{-1} was 17.6 to 23.9 and 19.9 to 24 respectively (table 4).

Post Harvest Fractination Study of Potassium in Soil and Its Relesing Characteristics

Perusal of data clearly showed that higher level of potassium application resulted in significant increase in water soluble, exchangeable and non-exchangeable K (Table- 5). Water soluble, exchangeable and non-exchangeable Kvaried from 11.9 to 24.7, 89.3 to 125.8 and 558.9 to 664.2 kg ha^{-1} respectively. Maximum value of water soluble Kwas recorded with the application of 200 % K in two splits (T_7) and found significantly superior over treatment receiving up to 150 % K either as basal or in 2 splits. However, 200 % K as basal (T_4) application was observed at par with its respective split application (T_7) in case of water soluble K. The application of 200 % K as basal (T_4) recorded maximum value of exchangeable and non-exchangeable K and resulted in 35.2 and 9.2 % increase in respective forms of potassium observed in initial status of soil which was more than control plots (T_1). The (T_4 treatment) also exhibited significant difference from treatments receiving 100 % K as basal (T_2) application and K omitted plot in case of non-exchangeable K. However, rest of the treatments found at par with 200 % K as basal (T_4) application. Among all the treatments, minimum value of water soluble, exchangeable and non-exchangeable K was recorded in potassium omitted plot.

Critical examination of data (Table-2) also revealed that increasing potassium level had no significant variation with respect to constant rate, lattice and total K content. No variation in the constant rate K may be attributed to the less availability of this interlayer fraction of non-exchangeable K reserve on K demand under K stress (McLean 1961). Value of constant rate, lattice and total K content ranged from 161.3 to 179.2, 30699.9 to 35810.2 and 31360.0 to 36586.7 kg ha^{-1} respectively.

Step K provides estimation of K avail from non-exchangeable form of K while constant rate K is a measure of difficultly available K of the mineral lattice sourced to the crops (Haylock 1956). Amount of K release in 1st extraction was highest which decreased subsequently with successive extraction and finally remained almost constant. Value of step K and total extractable K varied from 1069 to 1395 and 2091 to 2404 kg ha^{-1}. Highest value of total extractable K was found (2404 kg ha^{-1}) with the application of 200 % K as basal (T_4) while elimination of K from treatment (T_1) resulted in considerable decrease in step K from initial status of soil. The decrease in step K might be due to higher depletion of non-exchangeable K reserve by crops. Similar findings were reported by Mani and Sanyal (1997). The increase in water soluble, exchangeable and non-exchangeable K with increasing level of potassium application might be due higher potassium release from soils with the application of lower level of K as compared to the application of higher level K which resulted into higher fixation in soil after harvest of crop. Therefore, release of K for the next crop decreased with lower level of K application. The results are in the conformity with the findings of Hariprakasarao and Subramanian (1995) who reported highest potassium release from non-exchangeable K in current growing season of crop and subsequently highest fixation occurred after harvest of crops in K untreated plots. Majumdar *et al.* (2002) also reported the similar results.

Correlation coefficient among Soil Properties and K fractions of vegetable growing soils

Data presented in Table-6 indicate the correlation coefficient among soil properties after harvesting of bottlegourd. The pH was positively and significantly correlated with water soluble K (r= 0.44^{*}). Organic carbon also exhibited significant and positive correlation with water soluble (r= 0.66^{**}), exchangeable (r= 0.59^{**}) and non-exchangeable K (r= 0.76^{**}). However, with available N (r= -0.78^{**}) and P (r= -0.49^{*}), it was found to be negatively and significantly correlated. Available N, P and S also exhibited significant but negative correlation with water soluble and non-exchangeable K. Available N was significantly and positively correlated with available P (r= 0.58^{**}) and S (r= 0.59^{**}). Similarly, available P also showed significant and positive correlation with available S (r= 0.70^{**}). Water soluble K was found to be significantly and positively correlated with exchangeable (r= 0.64^{**}) as well as non-exchangeable K (r= 0.78^{**}). Similarly, exchangeable K also exhibited significant and positive correlation with non-exchangeable K (r= 0.72^{**}). Significant and positive correlation among different forms of potassium (except total K) indicated the existence of equilibrium among the comparatively easily available forms of K and thus depletion of one form was replenished by other forms of K. Srinivasa *et al.* (1997) also reported the similar results. Comparatively high degree of correlation of available Kwith exchangeable K (r= 0.98^{**}) than with water soluble K (r= 0.78^{**}) showed that soil exchangeable phase played more significant role in regulating the availability of K. The results are in agreement with the findings of Srivastava *et al.* (1998). Lattice K was found highly significant and positive correlated with total K (r= 1.00^{**}).Application of K in soil at higher level showed significant enhancement in different forms of K. Water soluble Kcomprised a very small fraction among all. A significant and positive correlation were observed among water soluble, exchangeable and non-exchangeable K in most of the cases. Correlation study revealed presence of dynamic equilibrium among water soluble, exchangeable and non-exchangeable K. Therefore, the removal of one form of K can be replenished by other forms of K in soil. Bulk of total K in soil was present in the form of lattice K (97.751 to 98.549 %) that remained statistically unaffected with increasing level of K application. Total K content of soil was not affected with increasing level of K application. The mean value of total K ranged from 31,360 to 65,706 Kg ha^{-1}. Step K and cumulative K release from the soil showed a linear increase with increasing level of K application. The minimum step K and cumulative K release was observed in K omitted plot while 200% K as basal application recorded maximum content of step K and cumulative K release in most of the cases. Constant rate K did not show a definite trend with increasing level of K application and remained statistically unchanged.The pH and organic carbon did not vary significantly due to increasing level of Kapplication. However, a slight increase in both the content was noticed at higher level of K application.

IV. Conclusions

The data of two year study indicated that it is not possible to obtain optimum yield and quality with the application of only nitrogen and phosphorous in the study area of Ranchi (Jharkhand state). The application of potassium is essential to obtain higher yield and also to enhance the nutritive value through improved bio-chemical properties. Although the maximum yield was obtained at the highest level of applied Potassium,

however, for working out the best dose of a fertilizer application in addition to fruit yield, other factors also need to be considered. There is no doubt that benefit cost ratio was the highest at 60 kg K_2O ha^{-1} application, after taking into account the crop yield and all other quality parameters. It can be concluded that application of fertilizers at the rate of 90 kg N, 40 kg P_2O_5 and 60 kg K_2O(1/2+1/2) ha^{-1} is the best option for Alfisol soils of Jharkhand

Reference

[1]. Ali, S.M. Moghadem, H.H., Yazdani, D. and Avval, P.A., (1999). Effect of plastic mulches, spacing, nitrogen, phosphorus and potassium fertilizer levels on the growth and yield of common pumpkin (*Cucurbita pepo* var. Styrica). *Journal of Medicinal and Aromatic Plant Sciences*, 21 (3) : 650-653.

[2]. Attoe, J. and Through, E. (1946) Exchangeable N, acid soluble K as regards availability and reciprocal relationship. *Proceedings of Soil Science Society of America* **10**, 81-86.

[3]. B.I. Bidari and N.S. Hebsuk (2011). Potassium in relation to yield and quality of selected vegetable crops – *Karnataka Journal Agriculture Science* 24 (1) : 55-59.

[4]. Brady, N.C. and Weil, R.R. (1999) The nature and properties of soils. *9th Edition. Macmillan Publishing Company New York*, 750

[5]. Bray, R.H. and Kurtz, L.T. (1945) Determination of total, organic and available forms of phosphorus in soils. *Soil Science* **59**, 39-43.

[6]. Chesnine, L. and Yien, C.H. (1951) Turbidimetric determination of available sulphates. *Proceedings of Soil Science Society of America* **15**, 149-151.

[7]. Hanway, J.J. and Hiedel, H. (1952) Soil analysis method as used in Iowa state college soil testing Laboratory. *Iowa Agriculture* **57,** 1-31.

[8]. Hariprakasarao, M. and Subramanian, T.R. (1995) Potassium supplying capacity of soil in relation to intensive vegetable cropping. *Journal of Potassium Research* **11**(2), 133-142

[9]. Hedge, J.E. and Hofreiter, B.T. (1962). In Carbohydrate Chemistry, 17 (Eds. Whistler R.L. and Be Miller, J.N.), Academic Press, New York.

[10]. Jifon, J.L. and G.E. Lester (2009). Foliar potassium fertilization improves fruit quality of field grown muskmelon on calcareous soils in south Texas. *Journal Science Food and Agriculture* 89 : 2452-2460.

[11]. Jackson, M.L. (1967&1973). *Soil Chemical Analysis*, Indian Edition. Prentice-Hall India Pvt. Ltd., New Delhi.

[12]. Lester, G.E, J.L. Jifon and D.J. Makus (2006). Supplemental Foliar Potassium Applications with and without surfactant can enhance netted muskmelon quality. *Hort Sci.* 41 (3) : 741-744.

[13]. Madhu Modgil, Rajni Modgil and R. Kumar (2004). Carbohydrate and mineral content of Chyote (*Sechium edule*) and Bottle gourd (*Lagenaria Scieraria*) *J. Hum, Ecol.*, 15 (2) : 157-159

[14]. MaLean, A.J. (1961) Potassium supplying power of some Canadian soils. *Canadian Journal of Soil Science* **40**, 883-886.

[15]. Majumdar, B., Venkatesh, M.S., Kumar, K. and Patiram (2002) affect of levels of potassium and FYM on yield anduptake of nureints by sweet potato and different forms of K in an acid alfisol of Meghalaya. *Journal of Potassium Research* **18**, 84-89.

[16]. Malick, C.P. and Singh, M.B. (1980). In *Plant Enzymology and Histo Enzymology*, Kalyani Publishers, New Delhi, p. 286.

[17]. Mani, P.K. and Sanyal, S.K. (1997) Non-exchangeable potassium reserves in an alfisol in relation to potassium uptake by potato. *Journal of the Indian Society of Soil Science* **45**(3), 469-474.

[18]. Marschner, H. (1995) Functions of mineral nutrients: macronutrients, In: *H. Marschner (ed.). Mineral nutrition of higher plants 2nd Edition. Academic Press, N.Y.* 299-312.

[19]. Means, R.L. and Parcher, J.V. (1965) *Physical Properties of Soils.* Prentice- Hall of India Ltd. New Delhi.

[20]. Miller, G.L. (1972). *Anal. Chemistry*., 31. P. 426.

[21]. M.S. Brar, Preeti Sharma, Amandeep Singh, N.S. Dhillon and S.S. Sandhu (2010). Effect of Potassium Nutrition on the yield quality and nutrient uptake by Sunflower. *J. of Indian Society of Soil Science* Vol. 58 (3), 344-346.

[22]. Maynard, A.J. (Ed.) (1970). *Methods in Food Analysis*, Academic Press, New York, p. 176.

[23]. Panse, V.G. and Sukhatme, P.V. (1985). Statistical Methods for Agricultural Workers. 3rd Edn., Indian Council of Agricultural Research, New Delhi, India, pp: 359

[24]. Patil, S.R., Desai, U.T., Pawar, B.G. and Patil, B.T., (1996). Effect of NPK doses on growth and yieldof bottle gourd cv. Samrat. *Journal of Maharashtra Agricultural Universities*, 21 (1) : 65-67.

[25]. Ravikumar, G.H. (2001). Investigations on seed production and post harvest techniques in cucumber (*Cucumis sativus* L.) cv. Poinsette. Ph.D. Thesis, University of Agricultural Sciences, Dharwad.

[26]. Rengel, Z., Damon, P.M. and Cakmak, I. (2008) *Physiologia Plantarum* **133,** 624-636.

[27]. Sen, A.T., Deb, B.C. and Bose, S.K. (1949) Potassium status and availability to crops of non-exchangeable potassium in some Indian red and laterite soils. *Soil Science* **68**, 291-305.

[28]. Snedecor, G.W. and Cochran, W.G. (1967) Statistical method. Oxford and IBH Publishing Co. Park Street, Kolkata-16.

[29]. Srinivasa, R.C., Jagdish, P., Singh, S.P. and Takkar, P.N. (1997) Distribution of forms of potassium and Krelease kinetics in some vertisol profiles. *Journal of Indian Society of Soil Science* **45**, 465-468.

[30]. Srivastava, A.K., Kohli, R.R. and Huchche, A.P. (1998) Relationship of leaf K and forms of soil K at different growth stages of Nagpur Mandarin. *Journal of Indian Society of Soil Science* **46**(2), 245-248.

[31]. Tisdale, S.L., Nelson, W.L. and Beaton, J.D. (1985) Soil and Fertilizer Potassium. In *S.L. Tisdale, W.L. Nelson, and J.D. Beaton (eds). Soil Fertility and Fertilizers, 4th ed. Macmillan, New York* **7**, 249-291.

[32]. Walkley, A. and Black, C.A. (1934) An examination of the Degtijareff method for determining soil organic matter, and proposed modification of the chromic acidification. *Soil Science* **37**, 29-38.

[33]. Wiklander. L. (1954) Forms of potassium in the red soil. In *Potassium Symposium* I.P.I. Bern.

[34]. Williams, C.H. and Steinberg, A. (1959) Soil sulphur fractions as chemical indices of available sulphur in some Australian soils. *Australian Journal of Agricultural Research* **10**, 340-352.

[35]. Wood, L.K. and De Turk, E.E. (1941) The absorption of potassium in soils in non replaceable forms. *Proceedings of Soil Science Society of America* **5**, 152-161.

Table 1: Effect of potash on bio-chemical properties of bottle gourd grown in different locations

Treatments	Carbohydrate (%)	Phenol (mg/100g)	TSS (^{0}brix)	Protein (%)	Crude fiber (%)
FFP	3.14	66.56	3.13	2.56	2.5
$N_{80}P_{40}K_{40}$	4.18	89.93	2.93	2.30	3.0
$N_{80}P_{40}K_{(20+20)}$	4.24	97.14	2.53	2.31	2.67
$N_{80}P_{40}K_{60}$	4.62	103.13	2.83	2.10	2.83
$N_{80}P_{40}K_{(30+30)}$	4.68	106.45	2.60	1.92	3.17
$CD_{(0.05)}$	0.3	9.86	0.11	0.10	0.63
$CV_{(\%)}$	3.3	5.65	2.16	2.35	18.96

Table 2: Effect of Potash on Yield(t/ha) of Bottle Gourd grown in different location (mean of 2 years).

Treatment	Pithoria	Simar Tola	Ormanjhi	Patratu	Mean	Marketable yield(t /ha)
FFP	11.23	9.71	7.2	8.5	9.16	7.14
$N_{80}P_{40}K_{40}$	15.67	12.3	13.1	14.37	13.86	13.17
$N_{80}P_{40}K_{(20+20)}$	16.86	15.1	14.57	15.6	15.53	14.91
$N_{80}P_{40}K_{60}$	18.73	16.7	15.75	17.23	17.10	16.76
$N_{80}P_{40}K_{(30+30)}$	19.62	17.25	16.55	21.58	18.75	18.19

$CD_{(0.05)}$					1.6	
$CV_{(\%)}$					6.9	

Table 3: Effect of potassium on nutrient concentration of Bottle Gourd

Table 4: Economics of Potassium fertilizerE application.

treatment	MOP added (Kg/ha)	Cost of fertilizer(Rs)	Bottle gourd yie ld (t/ha)	Additional yie ld(t/ha)	Additional income(Rs)	VCR
FFP	0	0	9.16	0	0	0
$N_{80}P_{40}K_{40}$	66.7	1333.3	13.86	4.7	23,500	17.6 : 1
$N_{80}P_{40}K_{(20+20)}$	66.7	1333.3	15.53	6.37	31,850	23.9 : 1
$N_{80}P_{40}K_{60}$	100	2000	17.1	7.94	39,700	19.9 : 1

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