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Effect of integrated nutrient management on quality of broccoli under Lucknow condition

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Abstract
The present investigation was carried out with Broccoli cv. Pusa KTS-1 in a randomized block design with three replications on effect of integrated nutrient management on quality of Broccoli (*Brassica oleracea* L.var. *italica* Plenk) at the Horticulture Research Farm -1, Babasaheb Bhimrao Ambedkar University (a central university) Vidya Vihar, Rae Bareili Road Lucknow, during Rabi season of 2015-2016. The experiment comprised of 12 different combinations of three different sources of nutrients including organic, inorganic fertilizers and micronutrients which were applied following the proper procedures as per treatment various parameters are observed Acidity percentage, dry weight of curd g., Dry matter in curd % and chlorophyll content mg/100g), in table 1. T.S.S (^{0}Brix) vitamin C mg /100 ml, total sugar %, reducing sugar % and non reducing sugar %, in table 2. The result revealed that the maximum T.S.S. reducing and non reducing was found under the treatment T_{10} (T_{10}- RDF in which second top dress dose of N in urea from was replaced through UVM-1) and maximum chrollophyll content found under the treatment T_1 and total sugar, dry matter in curd and dry weight of curd under the treatment T_6 (T_6- RDF + 500 kg/ha OSV-2) found better compression other treatment.

Keywords: Integrated nutrient management, quality, broccoli

Introduction
Cruciferous vegetables are large and increasingly important vegetables. Broccoli, a member of the crucifer family of vegetables, is a rich source of sulforaphane, which has been shown to display potent anti carcinogenic properties. Broccoli (*Brassica oleracea* L. var. *italica* Plenk) is a nutritionally important crop grown all over the world having important nutritional values due to its content of vitamins, antioxidants, glucosinolates and anti-carcinogenic compounds (Parente *et al*., 2013). 100 gram broccoli contains Carbohydrate 7g (2%), Fat-0.4g., Sodium-33 mg (1%), Potassium-316 mg (9%), Dietary fiber 2.6g (10%), Sugar-1.7g, Protein-2.8 g, Vitamin A-12%, Vitamin C–148%, Calcium-4%, Iron-3%, Vitamin B_6-10%, Magnesium-5%, Phosphorus 79 mg. (Annonymus-2015). The curd of broccoli is a rich source of vitamin-K and B-complex group of vitamins like niacin (Vit. B-3), pantothenic acid (Vit. B-5), pyridoxine (Vit. B-6), and riboflavin. Further, its florets also hold some amount of omega-3 fatty acids. Broccoli contains indole-3-carbinol which helps to fight breast and lung cancer (Anon, 2006) [2]. In the last few decades, production of vegetable crops has been enhanced manifolds by the excessive use of chemical fertilizers and pesticides (Sharma *et al*., 2008) [10]. Nutrient management is the key factor, which influences the productivity and quality of any crop. Organic manures are considered helpful in improving the physical and nutritional status of the soil and also enhance the activity of soil microflora. (Ekta *et al*., 2017) [4] the effect of organic, inorganic fertilizers and micronutrients on nutrient quality of broccoli. The use of organic soil amendments has been associated with desirable soil properties including higher water holding capacity, cation exchange capacity, and lower bulk density as well as fostering beneficial microorganisms (Drinkwater *et al*., 1995) [3].

Materials and Methods
The present investigation on effect of integrated nutrient management on quality of Brocolli (*Brassica oleracea* L.var. *italica* Plenk) was carried out at the Experimental Farm of the Horticulture Research Farm -1, Babasaheb Bhimrao Ambedkar University (a central university) Vidya Vihar, Rae Bareili Road Lucknow, during Rabi season of 2015-2016 by adopting Randomized Block Design with three replications. Luck now is located in central zone of Uttar Pradesh and is characterized by sub-tropical climate with moderate rainfall

(1000-1100 mm). Geographically; Lucknow is situated at 26^0 50′ N latitude, 80^0 52′ E longitude and altitude of 123 meter above mean sea level (MSL). The details of treatment schedules are There were twelve treatment combinations which included various combinations of organic, inorganic fertilizers and micronutrients *i.e.*, T_0-Control, T_1- Recommended dose of fertilizer (RDF) (100% NPK), T_2- Fertilizer product OPV-1 equal to P in T_1 rest as urea, MOP. (RDF, OPV-1), T_3- Fertilizer product OPV-2 equal to P in rest urea MOP (RDF, OPV 2), T_4 RDF + 500 kg/ha silicon, T_5- RDF + 1000 kg/ha OSV-1, T_6- RDF + 500 kg/ha OSV-2, T_7- RDF + 1000 kg/ha, T_8-RDF in which basal dose of N in urea form was replaced through UVM-1, T_9- RDF in which first top dress dose of N in urea from was replaced through UVM-1, T_{10}- RDF in which second top dress dose of N in urea from was replaced through UVM-1, T_{11}- RDF in which total dose of N in urea form was replaced through UVM-1. The statistical analysis of the data recorded in all observations was carried out by using the F-test (Gomez and Gomez, 1984). Comparison of the treatments was made with the help of critical differences (CD).

Results and Dissuasion

The data pertaining to the various observations recorded on quality parameters for application of integrated use of organic, inorganic fertilizers and micronutrients significantly influenced the T.S.S (^{0}Brix) vitamin C mg /100 ml, total sugar %, reducing sugar %, non reducing sugar %, chlorophyll content mg/100g), acidity %, dry matter in curd % and dry weight of curd g. The data pertaining to the various observation recorded on quality parameter in broccoli have been show in table 1. The treatment T_{10} (T- RDF in which second top dress dose of N in urea from was replaced through UVM-1) exhibited highest acidity (0.49%) comparison by other treatment followed by T_{11} (T_{11}- RDF in which total dose of N in urea form was replaced through UVM-1), (0.46%) and Treatment T_3 (T_3- Fertilizer product OPV-2 equal to P in rest urea MOP.) (0.43%). The treatment T_6 (T_6- RDF + 500 kg/ha OSV-2 (0.31%) followed by T_4 (T_4 -RDF + 500 kg/ha silicon (0.32) and T_1 and T_0 (T_1- Recommended dose of fertilizer (RDF) (100% NPK and T_0- control) (0.35 and 0.35%) respectively, are similar result are found. Dry weight of curd was recorded at the time of harvesting was noted in table 1. Highest dry matter content in (9.56) Treatment T_6 (T_6- RDF + 500 kg/ha OSV-2) followed by (9.53g, 9.53g) T_6 and T_7 (T_6- RDF + 500 kg/ha OSV-2, T_7- RDF + 1000 kg/ha) respectively, and lowest dry matter (7.40) content in T_0 (Control) followed by (8.49) Treatment T_2 (T_2-Fertilizer product OPV-1 equal to P in T_1 rest as urea, MOP) might be due to the higher uptake of nutrient due to the release of sufficient by the process of mineralization at a constant level that in term gave higher dry matter content (Singh and Dutt, 1997) also noted similar results. The maximum dry matter content in curd (13.06) was noted in treatment T_6 (T_6- RDF + 500 kg/ha OSV-2) it might be due to the release of sufficient quantity of nutrient by the process of mineralization at a constant of nutrient by the process of mineralization at a constant level that in turn gave higher dry matter. The minimum dry matter content in curd (11.13) was obtained in treatment T_7 (T_7- RDF + 1000 kg/ha) similar result were also noted by (Kumar *et al*., 2013) in broccoli. The maximum chlorophyll content in (35.90) was noted in treatment T_1 (T_1 - Recommended Dose of Fertilizer (RDF) (100 % NPK) followed by (53.53) T_2- Fertilizer product OPV -1 equal to P in T_1 rest as urea, MOP. (RDF OPV-1) and (53.2) T_8 Recommended Dose of Fertilizer (RDF) which basal dose of N in urea form replaced through UVM-1 respectively. The minimum chlorophyll content (27.2) under the treatment T_0 (control) followed by (31.16) in treatment T_{10} (T_{-10} Recommended Dose Of Fertilizer (RDF) which second top dress dose of N in urea from replaced through UVM-1).

The data pertaining to the various observations recorded on quality parameter T.S.S (^{0}Brix) vitamin C mg /100 ml, total sugar %, reducing sugar %, non reducing sugar %, in broccoli have been show in table 2. The maximum T.S.S. was recorded by application of treatment (T_{10}- RDF in which second top dress dose of N in urea from was replaced through UVM-1) (8.69) followed by treatment T_4 and T_5 (T_4 RDF + 500 kg/ha silicon, T_5- RDF + 1000 kg/ha OSV-1)(8.20, 8.20) respectively, and lowest T.S.S was recorded by the application of T_0 (T- control) (7.43) followed by treatment T_6 (T_6- RDF + 500 kg/ha OSV-2) (7.68) and Treatment T_8 (T_8- RDF in which basal dose of N in urea form was replaced through UVM-1) (7.68) respectively. (Mishra *et al*., 2014) [8] in knoll khol, reported that the T.S.S. content was increased with the increase in the nutrient level in the soil. The study regarding vitamin C content indicated that the ascorbic acid content in curd. Decrease significantly with application of high nutrient. The highest ascorbic acid content (87.61) in curd was obtain with the treatment T_6 (T_6- RDF + 500 kg/ha OSV-2) followed by T_4 (T_4 -RDF + 500 kg/ha silicon) producing (87.34) milligram of ascorbic acid per 100g of juice. The lowest (81.52) ascorbic acid was recorded with the treatment T_0 (T_0-Control). These finding are in close agreement with those earlier reported by (Singh, 2004) [11] in cauliflower, Gua *et al*, 2004) [6] in cabbage Sable and Bhamare 2007 in cauliflower. These result corroborated with the findings of Bambal *et al*., (1998) in cauliflower, Upadhyay *et al*. (2012) [13] in cabbage, Qureshi *et al*. (2014) in kale and the Similar finding was obtained by Kotecha *et al*. (2016) in cabbage.. The maximum total sugar is found under the treatment T_5 (T_5- RDF + 1000 kg/ha OSV-1) (3.28) followed by T_7 and T_{10} (3.20 and 3.20) respectively, was found similar result. The minimum total sugar was found under treatment T_0 and Treatment T_{11} (2.78 and 2.78) respectively fallowed by treatment (T4-RDF + 500 kg/ha silicon**)** (2.90). The highest reducing sugar (3.03) was exhibited though (T_{10} - RDF in which second top dress dose of N in urea from was replaced through UVM-1) treatment T_{10}. While minimum (2.24) though T_0 (T_0-Control) and highest non reducing sugar (0.71%) was exhibited though (T_{10} - RDF in which second top dress dose of N in treatment T_{10}, while minimum (0.49%) though treatment (T_0- control).

Table 1: Effect of integrated nutrient management on acidity, dry weight of curd g., dry matter in curd% and chlorophyll mg./100g.

Symbols	Treatment	Acidity %	Dry weight of Curd g	Dry matter in curd %	Chlorophyll content (mg/100g)
T_0	Control	0.35	7.403	11.133	27.6
T_1	Recommended Dose of Fertilizer (RDF) (100 % NPK)	0.35	8.927	11.967	35.9
T_2	Fertilizer product OPV -1 equal to P in T1 rest as urea, MOP (RDF OPV-1)	0.43	8.98	12.753	35.53
T_3	Fertilizer product OPV-2 equal to P in rest urea MOP (RDF ;OPV -2)	0.39	8.49	12.143	34.53
T_4	Recommended Dose of Fertilizer (RDF) + 500 kg/ha Si	0.32	8.233	11.337	32.8
T_5	Recommended Dose of Fertilizer (RDF) + 1000 kg /ha OSV-1.	0.36	9.22	12.52	34.26
T_6	Recommended Dose of Fertilizer (RDF) + 500 kg /ha OSV-2	0.31	9.533	13.067	33.13
T_7	Recommended Dose of Fertilizer (RDF) + 1000 kg /ha OSV-2	0.42	9.563	11.63	33.4
T_8	Recommended Dose of Fertilizer (RDF) which basal dose of N in urea form replaced through UVM-1	0.38	9.17	12.207	35.2
T_9	Recommended Dose of Fertilizer (RDF) which first top dress dose of N in urea from replaced through UVM-1	0.36	9.537	12.19	32.3
T_{10}	Recommended Dose of Fertilizer (RDF) which second top dress dose of N in urea from replaced through UVM-1	0.49	9.07	11.087	31.16
T_{11}	Recommended Dose of Fertilizer (RDF) which total dose of N in urea form replaced through UVM-1	0.46	9.143	11.85	33.13
C.D (P=0.05)		1.05	1.065	1.103	2.59

Table 2: Effect of integrated nutrient management on T.S.S. (^{0}Brix), vitamin C, total sugar, reducing sugar and non reducing sugar.

Symbols	Treatment	T.S.S (^{0}Brix)	Vitamin C mg /100 ml	Total sugar %	Reducing sugar %	Non reducing sugar %
T_0	Control	7.43	81.52	2.78	2.44	0.49
T_1	Recommended Dose of Fertilizer (RDF) (100 % NPK)	8.03	83.40	3.07	2.79	0.54
T_2	Fertilizer product OPV -1 equal to P in T1 rest as urea, MOP (RDF OPV-1)	8.10	86.93	3.07	2.73	0.58
T_3	Fertilizer product OPV-2 equal to P in rest urea MOP (RDF ;OPV -2)	7.98	85.25	2.92	2.79	0.55
T_4	Recommended Dose of Fertilizer (RDF) + 500 kg/ha Si	8.20	87.34	2.90	2.75	0.54
T_5	Recommended Dose of Fertilizer (RDF) + 1000 kg /ha OSV-1.	8.20	85.97	3.23	2.73	0.53
T_6	Recommended Dose of Fertilizer (RDF) + 500 kg /ha OSV-2	7.68	87.61	3.01	2.32	0.68
T_7	Recommended Dose of Fertilizer (RDF) + 1000 kg /ha OSV-2	7.96	85.17	3.20	2.71	0.67
T_8	Recommended Dose of Fertilizer (RDF) which basal dose of N in urea form replaced through UVM-1	7.68	86.56	3.07	2.82	0.67
T_9	Recommended Dose of Fertilizer (RDF) which first top dress dose of N in urea from replaced through UVM-1	8.03	85.32	3.16	2.72	0.69
T_{10}	Recommended Dose of Fertilizer (RDF) which second top dress dose of N in urea from replaced through UVM-1	8.69	88.48	3.20	3.03	0.71
T_{11}	Recommended Dose of Fertilizer (RDF) which total dose of N in urea form replaced through UVM-1	7.84	83.20	2.78	2.24	0.57
C.D (P=0.05)		1.11	3.73	0.88	0.69	0.18

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