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Quality performance of vegetables grown under organic and integrated nutrient management production systems

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Abstract
A field experiment was carried out at Agronomy Farm, Dr. PDKV, Akola during *Rabi* season of 2017-18 on clayey soil. The experiment was laid out in factorial randomized block design with nine treatment combinations and four replications. Treatments consist of three nitrogen sources *viz*., 100% N through urea, 50% N through FYM + 50% N through urea and 50% N through FYM + 50% N through Vermicompost + Biofertilizers and three vegetables *viz*., Coriander, Fenugreek and Spinach. Experimental results revealed that higher chlorophyll content of the leaves of all vegetables was observed with application of 50% N through FYM + 50% N through urea than other nitrogen sources. In case of shelf life of leafy vegetables physiological weight loss was lowest which was produced by the application of 50% N through FYM + 50% N through Vermicompost + Biofertilizers. Fenugreek recorded lowest physiological weight loss in refrigerator, covered with wet cloth and at room temperature at 24 and 48 hours. Dark green colour of all vegetables was acceptable by 40% respondents, better aroma of all leafy vegetables, was experienced by 42% respondents and good taste was noted by 50% respondents which were resulted by the application of 50% N through FYM + 50% N though Vermicompost + Biofertilizers.

Keywords: Organic, INM, Vegetable, chlorophyll, organoleptic taste, aroma, self-life

Introduction
The balanced diet contains adequate energy source, nutrients and vitamins, minerals, carbohydrates, fats, protein etc. Vegetables are the reliable source for many dietary factors. As vegetable contain many of the dietary factors like vitamins, minerals and amino acids they are considered as protective supplementary food. India is the second largest producer of vegetables after China in the world. In India, it is grown in an area of 9.575 million hectares with productivity of 17.7 mt ha^{-1} which contributes 14% of the total world production of vegetables. West Bengal, Uttar Pradesh, Bihar, Madhya Pradesh, Odisha, Gujarat and Karnataka are major vegetables growing states. Per capita availability of vegetables in India is 375 g /person /day which help in fighting nutrition [10]. Several vegetables are grown in India out of this spinach, coriander, fenugreek are important and regular ones.
The sole use of inorganic fertilizers depleted the natural resources. Excessive application of these fertilizers not only pollute underground water but also produce certain undesirable chemicals through processes like volatilization, denitrification, etc. thereby causing various diseases in plants and animals. Organic manures are useful in improving soil properties such as porosity, water holding capacity, infiltration, organic carbon and nutrient availability without any hazardous residual impacts. For optimum productivity, quality of crops and good soil health, it is essential to adopt suitable packages developed under INM system with judicious utilization of inorganic, organic and Bio-fertilizers.

Material and Methods
The field experiment was conducted in the experiment field of Department of Agronomy, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the academic year 2017. The experiment was laid out in factorial randomized block design with nine treatment combinations and four replications. Treatments consist of three nitrogen sources *viz*., 100% N through urea, 50% N through FYM + 50% N through urea and 50% N through FYM + 50% N

through Vermicompost + Biofertilizers and three vegetables *viz*., coriander (ACr - 1), fenugreek (Pusa early branching) and spinach (All green). Fertilizers and manures are applied as per recommended fertilizer dose.

The chlorophyll content in leaf was estimated by adopting the procedure given by Hiscox and Isregelston [5] and extraction of chlorophyll was done with DMSO (dimethylsuphoxides) method. For estimation of self life of vegetables, each plant type of spinach, coriander, fenugreek was weighted for 125 gm each and kept at room temperature, wrapped in wet cloth and refrigerator for 2 days weight loss is recorded after 24 hours and 48 hours [6].

Organoleptic test was conducted by focusing on customer taste preference mainly on sensory evolution within organic, inorganic and vegetables grown under INM and acceptance (%) was calculated on the basis of preference.

Result and Discussion

A. Chlorophyll content (Mg g^{-1})

Chlorophyll is one of the important pigment contents which is used as index of plant production capacity and metabolic activity. Chlorophyll is an integral compound that plays important role in photosynthesis. Relevant data pertaining to chlorophyll content are presented in Table 1 and 2. General mean for chlorophyll ranged from 1.17 mg g^{-1}, 0.71 mg g^{-1}, and 1.88 mg g^{-1} for chlorophyll 'a' chlorophyll 'b' and total chlorophyll respectively.

Table 1: Chlorophyll content (mg g^{-1}) of leafy vegetables as influenced by various treatments

Treatments	Chlorophyll a	Chlorophyll b	Total Chlorophyll
Factor A (Nitrogen sources)			
N_1 - 100% N through urea	1.11	0.59	1.70
N_2 - 50% N through FYM + 50% N through Urea	1.27	0.87	2.14
N_3 - 50% N through FYM + 50% N through Vermicompost + Biofertilizers	1.12	0.66	1.79
SE(m)±	0.04	0.06	0.08
CD (P=0.05)	0.11	0.19	0.24
Factor B (Vegetables)			
V_1 - Coriander	1.42	0.57	1.99
V_2 - Fenugreek	0.89	0.80	1.69
V_3 - Spinach	1.20	0.75	1.95
SE(m)±	0.04	0.06	0.08
CD (P=0.05)	0.11	0.19	0.24
Interaction (N XV)			
SE(m)±	0.07	0.11	0.14
CD (P=0.05)	NS	NS	0.42
GM	1.17	0.71	1.88

Effect of sources of nitrogen

Different organic and inorganic sources of nitrogen recorded distinction in chlorophyll content. Significantly highest chlorophyll content was observed with application of 50% N through FYM + 50% N through urea followed by 50% N through FYM + 50% N through vermicompost + biofertilizers and 100% N through urea in Chlorophyll a, b and total chlorophyll respectively. More chlorophyll content might be due to beneficial impact of major and micronutrients supplied by organic manures, inorganic fertilizers which would retard senescence and improve photosynthets assimilation. These findings are in line with Ashaf *et al*. [2] and Kumar *et al*. [7].

Effect of vegetables

In case of Chlorophyll a and total chlorophyll coriander has significantly highest Chlorophyll content in than fenugreek and spinach. With regards to chlorophyll b fenugreek recorded highest chlorophyll content.

Interaction effect

Highest chlorophyll content was recorded by combination of 50% N through FYM + 50% N through urea applied to Fenugreek crop. This might be due to inherent genetical character of leaf in Fenugreek with availability of nitrogen from integrated nutrient sources.

Table 2: Mean Interaction of total chlorophyll Nitrogen sources (N_2) × Vegetables (V_2)

Treatments	N_1	N_2	N_3	Total	Mean
V_1	2.07	1.19	1.85	5.10	1.70
V_2	1.96	2.26	2.22	6.43	2.14
V_3	1.95	1.63	1.78	5.37	1.79
Total	5.97	5.08	5.85	16.90	
Mean	1.99	1.69	1.95		
SE(m)± - 0.14					
CD (P=0.05) - 0.42					

B. Shelf life: Physiological weight loss (PWL) (%)

Shelf life is a time period that a product can be expected to maintain a predetermined quality of produce under specified storage condition. The data on shelf life (%) as influenced by different treatments are presented in Table 3. At room temperature average weight loss in biomass was 57.45%, while 21.57% loss was recorded from vegetables covered with wet cloth and minimum weight loss of leafy vegetables 10.58% was observed from refrigerator in 24 hours. At second day 77.01% physiological weight was observed at room temperature while it was 31.64% loss in wet cloth and 19.47% in refrigerator. Freshly cut leafy vegetables have very short shelf life.

Effects of sources of nitrogen

Minimum physiological weight loss in vegetables was

recorded by the application of 50% N through FYM + 50% N through vermicompost + biofertilizers and maximum weight loss was observed with application of 100% N through urea both in 24 and 48 hours. The storage life may be reduced due to high rates of respiration and transpiration. There is possibility of enzymatic and microbiological deterioration. After 48 hours marketability is reduced and customer preference is very low after 2 days especially for vegetables kept at room temperature as well as for vegetables kept in wet cloth. The increased shelf-life of vegetables may be attributed to effect of the growth substances which are stimulated by the use of biofertilizers and organic manures which slow down the physiological process like respiration which leading to better retention of moisture and increased their shelf-life [1]. Bhattarai and Budathoki [3] also reported that in cauliflower the higher weight loss occurs when chemical fertilizers are added, might be due to lack of availability of micronutrients to crop. These micronutrients are required for strengthening the cellular parts of fruits and hence the physiological loss in weight might be less. The chemical fertilizers increased the accumulation of moisture content in fruits and naturally more moisture content increased the physiological loss in weight.

Table 3: Shelf life: physiological weight loss (%) of leafy vegetables as influenced by various treatments

Treatments	Physiological weight loss (%)					
	24 hours			48 hours		
	Room temp. 25 °C	Wet Cloth 12 °C	Refriger- ator < 4 °C	Room temp. 25 °C	Wet Cloth 12 °C	Refriger-ator < 4 °C
Factor A (Nitrogen sources)						
N_1-100% N through urea	59.44	22.05	11.50	78.76	33.42	21.05
N_2-50% N through FYM + 50% N through Urea	56.68	21.56	10.27	77.42	31.44	19.25
N_3-50% N through FYM + 50% N through Vermicompost + Biofertilizers	56.23	21.10	9.97	74.85	30.07	18.11
SE(m)±	0.35	0.26	0.23	0.22	0.19	0.21
CD (P=0.05)	1.01	0.75	0.68	0.63	0.56	0.61
Factor B (Vegetables)						
V_1-Coriander	74.68	24.30	11.93	84.68	35.08	22.22
V_2-Fenugreek	45.12	18.78	8.62	68.83	28.88	15.68
V_3-Spinach	52.57	21.64	11.19	77.52	30.97	20.51
SE(m)±	0.35	0.26	0.23	0.22	0.19	0.21
CD (P=0.05)	1.01	0.75	0.68	0.63	0.56	0.61
Interaction (N XV)						
SE(m)±	0.60	0.44	0.40	0.37	0.33	0.36
CD (P=0.05)	NS	NS	NS	NS	NS	NS
GM	57.45	21.57	10.58	77.01	31.64	19.47

Effect of vegetables

In vegetables varying range of weight loss was observed. Fenugreek showed minimum weight loss than coriander and spinach at room temperature, wet cloth as well as in refrigerator. None of the interaction was significant among nitrogen sources and vegetables.

C. Organoleptic taste

Organoleptic liking of green leafy vegetables by respondents is given in Table 4. About 35% respondents said that organically grown vegetables i.e. under treatment of 50% N through FYM + 50% N through vermicompost + Biofertilizers had dark green and lustrous colour. In a same way, 40% respondents observed dark green and lustrous colour with integrated nutrient management (50% N through FYM +50% N through Urea) and 25% showed preference with inorganically produced vegetables (100% N through urea).

Table 4: Organoleptic test of leafy vegetables by respondents as influenced by various treatments

Parameters	Organically grown Vegetables (50% N through FYM + 50% N through Vermicompost +Biofertilizers)	Vegetable grown under INM (50% N through FYM + 50% N through Urea)	Inorganically grown Vegetables (100% N through Urea)
Organoleptic Liking (%)			
Colour	35	40	25
Aroma	42	38	20
Taste	50	28	22

In respect to aroma, 42% respondents noticed pleasant aroma when vegetables when grown with organic treatment (50% N through FYM+ 50% N through urea). About 38% respondents observed that leafy vegetables produced by integrated nutrient management (50% N through FYM + 50% N through Urea) had better aroma and 20% observers narrated that inorganically grown vegetables had better aroma.

Among respondent who tested the green vegetables for taste, 50% eaters noticed that vegetables grown with 50% N through FYM + 50% N through Vermicompost + Biofertilizers was having very good taste. Likewise, preference was given by 28% respondents who gave preference to vegetables grown with treatment of 50% N through FYM + 50% N through Urea whereas, 22% respondents voted for inorganically grown vegetables for very good taste. Similar results were also reported by Rathore *et al*. [9]. Many scientists including Feltman [4] and Linder [8] have also claimed that organically grown fruits, vegetables and grains taste better than conventionally grown.

Conclusion

Experimental results revealed that quality parameters *viz*,

chlorophyll content, shelf life, organoleptic test of leafy vegetables (spinach, coriander and fenugreek) were improved with organic nutrient sources with application of 50% N through FYM + 50% N through Vermicompost + Biofertilizers.

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