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Effect of nutrient levels and mulching materials on yield of bell pepper (*Capsicum annum* L.) under West Bengal condition

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Abstract
The field experiment was conducted to study the effect of nutrients and mulching on fruit yield of Bell pepper at Horticulture farm, Institute of Agriculture, Visva-Bharati, Sriniketan (West Bengal) during *rabi* season 2014-15. The experiment was laid out in Completely Randomized Block Design (CRBD) consisting of nine treatments. The treatment comprising of different combinations of nutrients and mulches *i.e.* Nitrogen (150Kg $ha^{-1}$and 200 Kg ha^{-1}), Phosphorous (80 Kg ha^{-1} and 120 Kg ha^{-1}) and mulches (Paddy straw and water hyacinth each @ 7zt ha^{-1}) with three replications. The statistical analysis indicated that the fruit yield of bell pepper were significantly influenced by nutrients and mulching. The highest fruit yield per plant (739.31g), fruit yield per plot (12.67 kg) and fruit yield per hectare (21.12 t ha^{-1}) were recorded in treatment T_6 with 200kg N ha^{-1} + 80kg P_2O_5 ha^{-1} + Paddy straw mulch @ 7 t/ha^{-1}. Control condition indicated significantly lowest result than all other treatment. Considering the maximum benefit in terms of yield and economy, the treatment comprising of 200 kg N ha^{-1}, 120 kg P_2O_5 ha^{-1} and paddy straw mulch @ 7 t ha^{-1} (T_6) was found to be the best under present experiment condition.

Keywords: Nutrients, mulching, bell pepper

Introduction
Bell pepper also known as Bell pepper or Sweet pepper or Green pepper or Shimla mirch is one of the popular solanaceous vegetable crops cultivated in most parts of the world, especially in temperate regions of Central and South America and European countries, tropical and sub-tropical regions of Asian continent mainly in India and China. India contributes one fourth of world production of Bell pepper with an average annual production of 0.9 million tons from an area of 0.885 million hectare with a productivity of 1266 kg per hectare from open as well as protected cultivation (Anonymous, 2005) [2]. It is extensively cultivated in hills of Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir and Nilgiri hills during summer months. As an autumn crop, it extends up to winter months in Karnataka, Maharashtra, Tamil Nadu, Andhra Pradesh, Bihar, West Bengal and Madhya Pradesh (NHB, 2012-13).

Bell pepper can be consumed either by cooking or raw. The leaves are also consumed as salad, soups or eaten with rice (Lovelook, 1973) [7]. It was also used as folk medicine for black vomit, tome for gout and paralysis in Shimla hills. Nutritive value of sweet pepper is also very good as it is rich in vitamin A (3131IU), vitamin C (283 mg), protein (1.29 mg) and minerals like calcium (13.4mg), magnesium (14.9mg), phosphorus (28.3mg), potassium (263.0 mg) per 100 g of fresh weight. (Arya, P.S., 1999 and IIHR, 2000) [3].

Application of nutrients to support the crop plants for optimum production is well established through various research programmes, especially for the macronutrients like nitrogen, phosphorus and potassium. Crucial role of nitrogen for being main constituent of all amino acids in proteins and lipids, the structural compounds of cells and chloroplast made it the most essential macronutrient for good plant establishment and expected growth (Uddin and Khalequzzaman, 2003) [15]. Therefore, its deficiency shows negative impact on growth and development of plants which is ultimately reflected in reduced yield. Reports of various investigations indicated its significant role for application stimulating the plants for uptake of potassium and phosphorus through its synergistic effect (Qawasmi *et al*., 1999) [11]. Bell pepper requires heavy nitrogen application for higher yield as it imparts good vegetative growth necessary for good development of fruit. Phosphorus (P) is another important macronutrient vital for plant growth as it is involved in several key plant cellular activities like energy transfer, photosynthesis, transformation of sugars and starches and transfer of genetic characteristics from one generation to the next. It also promotes root proliferation that

increases root volume and improves soil nutrient exploration.
Water is the critical factor for growth and development of any crop. Favorable water balance maintained through irrigations may result in better maintenance of cell turgidity, better translocation of photosynthates, greater availability of nutrients leading to better plant growth and yield (Ali and Kushwaha, 1987) [1]. Raising of crop during *rabi* season in laterite belt of West Bengal has been threatened by various factors like low and erratic rainfall, deep ground water table and scarcity of alternative water resources. Bell pepper is a high value crop and it is susceptible to moisture stress and drought. Therefore, better water management through water conservation practices are necessary to maintain adequate soil moisture during critical periods of growth and development of the plants. Among all water conservation methods mulching is an important one and easy to adopt which reduces evaporation (Ekinci and Dursun 2009) [4], and increases availability soil moisture and thus enhances availability of nutrients to plants which ultimately affects yield and quality (Vanlalhluana and Sahoo 2011) [14]. Among mulches, organic mulches are an attractive option to improve soil organic matter through their biodegradation and easy availability. It improves vegetative growth, blooming and number of fruit per plant which leads to early maturity and early harvest (Gómez *et al.*, 1997) [5]. Use of organic materials for mulching provide opportunities for growers to recycle on-farm agricultural by-products and thus these are eco-friendly and economic as well.

Materials and Methods

The field experiment on capsicum was conducted at the Horticultural farm, Palli-Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan, West Bengal during December, 2014 to March, 2015 to study the effect of nutrients and mulching on growth and yield of capsicum. The experimental field is in the red and lateritic belt of West Bengal, situated at about 23º 42′ N latitude and 87º 40′ 30″ E longitude with an average altitude of 40 m above mean sea level.
The soil of experimental field was sandy loam having pH 6.1. The main field was prepared by thoroughly ploughing and leveling and then divided into plots. The size of individual plots was 3m x 2m and the whole area was intercept by irrigation cum drainage channels of 0.5m wide. The bunds besides irrigation channel are 15cm and border bunds & bunds in intra replication are 30cm. Bell pepper cv. Bharat was taken for experiment. First seedling was raised in the nursery and then 35 days old healthy seedlings were planted at spacing of 60X40cm in the main field plot.
The experiment was laid out in a Randomized Block Design (RBD) with three replications of nine treatments. The treatment consisted 9 different combinations of nutrient levels and mulches *i.e.* T_1 -150kg N/ha + 80kg P_2O_5/ha + Rice chaff mulch @ 7t/ha, T_2-150kg N/ha + 80kg P_2O_5/ha+ Paddy straw mulch @7t/ha, T_3 - 150kg N/ha + 120 kg P_2O_5/ha + Rice chaff mulch @7t/ha, T_4 - 150kg N/ha + 120kg P_2O_5/ha + Paddy straw mulch @7t/ha, T_5 - 200kg N/ha + 80kg P_2O_5/ha + Rice chaff mulch @7t/ha, T_6 - 200kg N/ha + 80 kg P_2O_5/ha + Paddy straw mulch @7t/ ha, T_7 - 200kg N/ha + 120kg P_2O_5/ha + Rice chaff mulch @7t/ha, T_8 - 200kg N/ha + 120kg P_2O_5/ha + Paddy straw mulch @7t/ha, T_9 - Control. All the experimental plants were uniformly maintained and same cultured practices were provided *i.e.* Irrigation, manuring, fertilizer application, gap filling, earthing up, harvesting and plant protection measures during whole period of investigation. Data regarding yield was recorded and statistically analyzed.

Results Findings and Discussion

Fruit yield per plant (g)

The range of fruit yield per plant varied from 297.06g to 739.31g among the different treatments. Analysis of result indicated increasing trend in fruit yield per plant apparently related with the increment in nutrient levels. However, the highest fruit yield per plant (739.31g) was observed in the treatment T_6 (200kg N/ha + 80kg P_2O_5/ha + Paddy straw mulch @ 7 t/ha) followed by T_8 (725.53g) with the application of 200kg N/ha, 120 kg P_2O_5/ha and paddy straw mulch @ 7 t/ha. The minimum and maximum increase in yield was 81.01% & 148.78% over control, respectively. On the other hand, the lowest fruit yield per plant was observed in T_9 (297.06g) with control condition.
Beneficial effect of nitrogen, phosphorous and mulching were already evident for different yield attributes especially in number fruit per plant and fruit weight, which might have positively contributed to fruit yield per plant. Higher level of nutrient in soil due to nutrient application and their availability to the plants for the presence of sufficient soil moisture conserved through mulching might have contributed positively for increased growth and yield attributes which were reflected in better fruit yield per plant. On the other hand, seemingly increased fruit yield per plant with paddy straw mulch at a definite level of nitrogen and phosphorus in comparison with rice chaff mulch might be due to ability to cover the soil more efficiently leading to better conservation of soil moisture with the former type apart from other benefits usually derived from mulching. The result is in line with findings of Kacha *et al.*, (2008) [6].

Yield per plot (Kg)

Significant variation of yield per plot was noted with different treatments applied through nutrients and mulches. The highest fruit yield per plot (12.67 kg) was observed in the treatment T_6 (200kg N/ha + 80P_2O_5 kg/ha + Paddy straw mulch @ 7 t/ha) which was closely followed in T_7 (12.0 kg) comprising of 200kg N/ha, 120kg P_2O_5/ha and rice chaff mulch @ 7 t/ha. Among all the treatments lowest fruit yield per plot (6.45 kg) was recorded under controlled condition (T_9) which was significantly lower than rest of the treatments.
The response of the plants in different plots of this field trial showed the beneficial effect of applied treatments consisting of nutrients like nitrogen and phosphorus and mulches on growth and development of plants compared to non-application of these components of treatments in control plot. Applied nutrients were readily available to plants due to conserved soil moisture through mulching which improved growth, flowering, number of fruit per plant, subsequent development of fruits with respect their length and diameter and finally individual fruit weight. The cumulative effect of all these characters mentioned above might have been reflected in this character.

Yield per hectare

Results from the experimental data indicated marked effect of nutrient and mulching on fruit yield (t/ha) of capsicum under various treatments. The maximum fruit yield of 21.12 ton per hectare was observed in the treatment T_6 (200kg N/ha + 80P_2O_5 kg/ha + Paddy straw mulch @ 7 t/ha) which was, however, *at par* with T_8 (20.57 t/ha) comprising of 200kg N/ha, 120P_2O_5 kg/ha and Paddy straw mulch @ 7 t/ha. The lowest fruit yield per hectare (10.75 t/ha) was observed in the plots under the treatment T_9, where mulch and nutrients like N and P were not applied (control).

Application of macronutrients like nitrogen and phosphorus is beneficial for their significant role in growth and development of any plants. Being an essential constituent of protein, nitrogen enhances cell proliferation and development which is manifested in growth of a plant. On the other hand, application of phosphorus not only promote root development which increases the absorption of nutrient elements along with soil moisture but also other physiological and metabolic activities including photosynthesis, transformation of sugars and starches etc. which is enhances growth and development of the plants especially various reproductive attributes. In this experiment, analyzed data indicated the benefits of applied nutrients for growth and different yield attributes like number of fruit per plant, average fruit weight, length and diameter of fruits and fruit volume. The cumulative effect of positive responses of these different attributes was ultimately reflected in the yield per hectare.

On the other hand, application of mulch not only conserves soil moisture but also reduces depletion of soil nutrients by smothering the weeds. In comparison with the response of the plants in the control plots, mulched plants treated with different levels of nutrients responded positively for various growths and yield attributes which might be due to better availability of soil moisture necessary for absorption nutrients and for various physiological and metabolic activities especially during critical period of moisture requirement of the plants. All these positive responses of different growth and yield attributes might have imparted positive contribution for better performance of the crop with respect to yield per hectare. The results are in conformity with findings of Sintayehu *et al*., (2015) [13], Ramakrishna and Palled (2003) [12], Muhammad *et al*., (2001) [10] in pepper, Manchanda *et al.*, (1988) [8] and Maya *et al*., (1997) [9].

Table 1: Effect of Nutrients and Mulching on yield per plant (g), yield per plot (Kg), yield (t/ha) of Bell Pepper

Treatments	Yield/Plant (g)	Yield/plot (Kg)	Yield (t/ha)
T_1-150kg N/ha + 80kg P_2O_5/ha + Rice chaff mulch @ 7t/ha	549.55^{f}	8.36^{d}	13.93^{d}
T_2-150kg N/ha + 80kg P_2O_5/ha + Paddy straw mulch @ 7t/ha	582.48^{e}	8.89^{cd}	14.83^{cd}
T_3-150kg N/ha + 120 kg P_2O_5/ha + Rice chaff mulch @ 7t/ha	697.94^{cd}	9.00^{cd}	15.00^{cd}
T_4-150kg N/ha + 120kg P_2O_5/ha + Paddy straw mulch @ 7t/ha	692.90^{d}	9.45^{c}	15.75^{c}
T_5-200kg N/ha + 80kg P_2O_5/ha + Rice chaff mulch @ 7t/ha	705.92^{cd}	10.66^{b}	17.77^{b}
T_6-200kg N/ha + 80kg P_2O_5/ha + Paddy straw mulch @ 7t/ha	739.31^{a}	12.67^{a}	21.12^{a}
T_7-200kg N/ha + 120kg P_2O_5/ha + Rice chaff mulch @ 7t/ha	713.15^{bc}	12.00^{a}	18.35^{b}
T_8-200kg N/ha + 120kg P_2O_5/ha + Paddy straw mulch @ 7t/ha	725.53^{ab}	11.89^{b}	20.75^{a}
T_9-Control	297.06^{g}	6.45^{e}	10.75^{e}
SEM(±)	4.48	0.22	0.34
CD (5%)	14.23	0.68	1.02
CV (%)	1.31	3.98	3.60

The superscript letter indicates that the treatment means with same letters are at par at 5% level of significance, while the means with different letters are significantly different at 5% level of significance. These letters have been affixed based on CD-value comparison of treatment means.

References

1. Ali M, Kushwaha BL. Cultivation of *rabi* rajmash in plains. Indian Farming. 1987; 2:20-23.
2. Anonymous. Chilly exports touch all-time high, 2005. Www.thehindubusiness.com.
3. Arya PS. Vegetable breeding and seed production. Kalyani Publishers, Ranjinder Nagar, Ludhiana, India, 1999.
4. Ekinci M, Dursun A. Effects of different mulch materials on plant growth, some quality parameters and yield in melon (*Cucumis melo* L.) cultivars in high altitude environmental condition. Pak. J Bot. 2009; 41(4):1891-1901.
5. Gómez O, Casanova A, Martínez L, Hernández JC, De Armas G, Santos R *et al*. Principales resultados científicos en Hortalizas y papa. Cultivo del tomate. Memorias 25 Aniversario Del Instituto de Investigaciones Hortícolas "Liliana Dimitrova". Cuba, 1997, 11-19.
6. Kacha RP, Sadhu AC, Tank DA, Gediya KM. Green fruit yield, quality and nutrient uptake by chillies (*Capsicum annuum* L.) as influenced by spacings, castor cake and nitrogen levels. Research on Crops. 2008; 9(2):356-359.
7. Lovelook Y. Various herbs species and condiments. The Vegetable Book. New York, St. Martin Press, 1973, 343.
8. Manchanda AK, Bhopal S, Singh B. Effect of plant density on growth and fruit yield of bell pepper (*Capsicum annuum* L.) Indian Journal Agronomy. 1988; 33(4):445-447.
9. Maya P, Natarajan S, Thamburaj S. Effect of spacing, N and P on growth and yield of sweet pepper *cv.* California Wonder. South Indian Horticulture. 1997; 45(1/2):16-18.
10. Muhammad S, Muhammad I, Noorul A, Muhammad A, Ziaur R. Effect of nitrogen and phosphorous on growth and yield of red chillies. Sarhad Journal of Agriculture. 2001; 17(4):549-551
11. Qawasmi W, Munir JM, Najim H, Remon Q. Response of bell pepper grown inside plastic houses to nitrogen fertigation. J Commun. Soil Sciences Plant Annals. 1999; 30(17):2499-2509.
12. Ramakrishna T, Palled YB. Effect of Plant Geometry and Fertilizer Levels Growth and Yield of Chilli. Karnataka journal Agricultural science. 2003; 18(4):892-895.
13. Sintayehu M, Ali M, Derbew B, Essubalew G. Impact of Organic Mulch Materials on Yield and Yield Attributes of Hot Pepper Varieties at Jimma, Southwest Ethiopia. American Eurasian Journal Agricultural & Environment Science. 2015; 15(11):2201-2210.
14. Vanlalhluana PC, Sahoo UK. Growth and yield of maize under different agro forestry systems exposed to varying cultural treatments in Mizoram, India. Science Vista. 2011; 11(1):11-15.
15. Uddin MK, Khalequzzaman KM. Yield and yield component of winter chilli (*Capsicum annum*) as affected by different level of nitrogen and boron. Pakistan Journal Biological Science. 2003; 6(6):605-609.