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Short Communication

Water use studies of bell pepper as influenced by different nutrient levels and mulching materials

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Abstract
The nutrient and mulching combination @ 200kg N ha^{-1} + 80kg P_2O_5 ha^{-1} + Paddy straw mulch @ 7 t/ha^{-1} tended to exhibit significantly decrease in water use and increase in water use efficiency (WUE) of bell pepper.

Keywords: Nutrient, mulching, bell pepper, water use, WUE

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 subtropical 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 (Love look, 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].
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) [8]. 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 (Gomez *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. Locally available organic mulches, such as paddy straw, rice husk, sawdust, grass, wheat straws are better options for selection as organic mulch in the present experiment.

The field experiment was conducted on Bell pepper at the Horticulture Farm, Institute of Agriculture, Visva-Bharati Shriniketan University during *rabi* season of 2014-15. The experiment was laid out in the randomized block design consisting of nine treatments *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 and plant protection measures during whole period of investigation. Data regarding water use and water use efficiency was recorded during the crop growth and statistically analyzed.

Among all the treatments lowest water use (284.73mm) recorded under plots mulched with paddy straw mulch irrespective of applied nutrients like nitrogen and phosphorus. Similarly, water use of the plants mulched with rice chaff mulch was recorded as 202.89mm. Among all the treatments highest water use 328.85mm was observed in control. Regarding water use efficiency, highest water use efficiency (74.16 kg $ha^{-1}mm^{-1}$) recorded in T6 (200kg N/ha + 80kg P_2O_5/ha + Paddy straw mulch @ 7t/ha), which was closely followed by T_8 (72.88mm) comprising of 200kg N/ha, 120kg P_2O_5/ha and paddy straw mulch @ 7t/ha. However, lowest water use efficiency (32.69 kg $ha^{-1}mm^{-1}$) was observed in control condition (T9).

Water use and water use efficiency are interrelated terms, lowest water use and highest water use efficiency of T_6 might be due to better mulching of soil surface firmly and reduced water loss due to evaporation which helped greater availability of water resulting in better translocation of applied nutrients. Paddy straw mulch is hydrophilic in nature, thus, it can absorb and retain moisture long time than rice chaff mulch. Evaporation of water from the paddy straw is comparatively lower than rice chaff mulch. Plants grown under control plot registered grater water use and lesser water use efficiency among all the treatments, which was due to more surface evaporation of soil moisture accentuated by direct exposure of soil to sunlight in absence of any covering material as used in other treatments in the form of paddy straw and rice chaff. These results are in agreement with Kirnak and Demirtas (2006) [6] identified in cucumber.

Table 1: Effect of Nutrients and Mulching on water use and water use efficiency of Bell Pepper

Treatments	Water use (mm)	Water use efficiency (kg/ha/mm)
T_1-150kg N/ha + 80kg P_2O_5/ha + Rice chaff mulch @ 7t/ha	302.89	45.99
T_2-150kg N/ha + 80kg P_2O_5/ha + Paddy straw mulch @ 7t/ha	284.73	52.08
T_3-150kg N/ha + 120 kg P_2O_5/ha + Rice chaff mulch @ 7t/ha	302.89	49.52
T_4-150kg N/ha + 120kg P_2O_5/ha + Paddy straw mulch @ 7t/ha	284.73	55.32
T_5-200kg N/ha + 80kg P_2O_5/ha + Rice chaff mulch @ 7t/ha	302.89	58.67
T_6-200kg N/ha + 80kg P_2O_5/ha + Paddy straw mulch @ 7t/ha	284.73	74.18
T_7-200kg N/ha + 120kg P_2O_5/ha + Rice chaff mulch @ 7t/ha	302.89	60.58
T_8-200kg N/ha + 120kg P_2O_5/ha + Paddy straw mulch @ 7t/ha	284.73	72.88
T_9-Control	328.85	32.69

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