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Effect of straw mulch on weed population, yield and keeping quality of potato under organic cultivation

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Abstract
An experiment was conducted to study the effect of two mulches level along with sixteen manures and bio-fertilizer levels on potato yield and keeping quality during 2010-11 and 2011-12. The experiment was laid out in split plot design with three replications. Crop was planted during the second week October in both growing season. Result showed that mulching significantly reduced the weed density and increased the tuber yield (297.48 q/ha) over the non-mulching (294.24 q/ha) treatment, whereas, application of manures and bio-fertilizer did not show any significant effect on weed density. The non-mulching treatment significantly reduced the physiological loss (11.15%) and decay loss (19.16%) of tuber over mulching after 60 days of harvesting in both growing seasons, respectively. Whereas, after 15 days of harvesting mulching treatment significantly reduced the physiological loss (2.08%) of tubers compared to the non-mulching. Application of vermicompost (6.0 t/ha) with bio-fertilizer recorded lowest physiological (11.43%) and decay loss (16.80%) of tuber in both growing seasons, while maximum physiological (14.74%) and decay loss (22.26%) was observed from bio-fertilizer alone.

Keywords: Mulch, organic, quality, weed population, yield

1. Introduction
Potato is fourth most important stable food crop after rice, wheat and maize of the world. Potato is used for vegetable, making chips, French-fries, boiled potatoes, baked potatoes, roasted potatoes, fried potatoes, potato salad, potato drink, potato powder, etc. Over the last few decades, awareness of people for the healthy food and policies on environmental safety promoted the production of organic food. Potato is highly responsive to application of organic manures (Mondal *et al.*, 2005) [8]. Potato is also sensitive crop to the soil moisture. Because of wider spacing and slow growth of potato during early stage of crop encourage the heavy infestation of weeds. Hand weeding is laborious, time consuming and expensive practices which also injures the root system of crop resulting in yield loss. The application of thick organic mulch as soil cover can reduce the weed infestation and evaporation losses improve plant growth resulting in increased crop yield in organic farming. Manures and bio-fertilizer applications also encourage the crop growth during the early stage which also suppress the growth of weeds and reduce evaporation losses. Keeping in view the weed control and losses of soil moisture in organic potato production, the research experiment was undertaken to find out the effect of mulching, manures and bio-fertilizer on weed control, yield and keeping quality in organic potato.

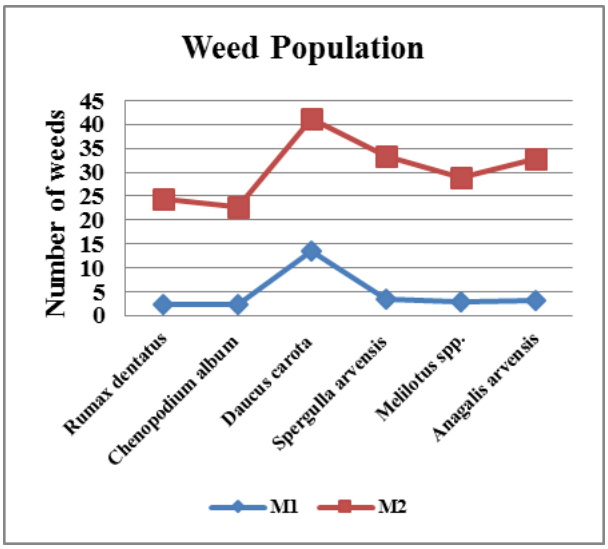
Materials and Methods
A field experiment was conducted during the winter season of 2010-11 and 2011-12 at Research Farm (29º10' N latitude and 75º46' E longitude) of Department of Vegetable Science, CCS Haryana Agricultural University, Hisar. The soil of experimental field was sandy loam in texture slightly alkaline in reaction and medium on organic C (0.47%), available N (145 kg/ha), available P (18.40 kg/ha) and available K (308.25 kg/ha). The experiment was laid out in split plot design with three replications. Crop was planted in second week of October 2010 and October 2011. The plot size was 13.30 m^2.
There were two mulching levels: M_1-Mulching and M_2-Non-mulching along with 16 manures and bio-fertilizer levels:

T_1 : Control,
T_2 : FYM @ 6.0 t/ha
T_3 : Vermi-compost (VM) @ 6.0 t/ ha
T_4 : Poultry manure (PM) @ 4.5 t/ha
T_5 : Biofertilizers [*Azotobactor*+Phosphorus soluble bacteria (PSB)]
T_6 : FYM @ 3.0 t/ha+VM @ 3.0 t/ha
T_7 : FYM @ 3.0 t/ha+PM @ 2.5 t/ha
T_8 : T_2+T_5
T_9 : VM @ 3.0 t/ha+PM @ 2.25 t/ha
T_{10} : T_3+T_5
T_{11} : T_4+T_5
T_{12} : FYM @ 2.0 t/ha+VM 2.0 t/ha+PM @ 1.5 t/ha
T_{13} : T_6+T_5
T_{14} : T_7+T_5
T_{15} : T_9+T_5
T_{16} : T_{12}+T_5

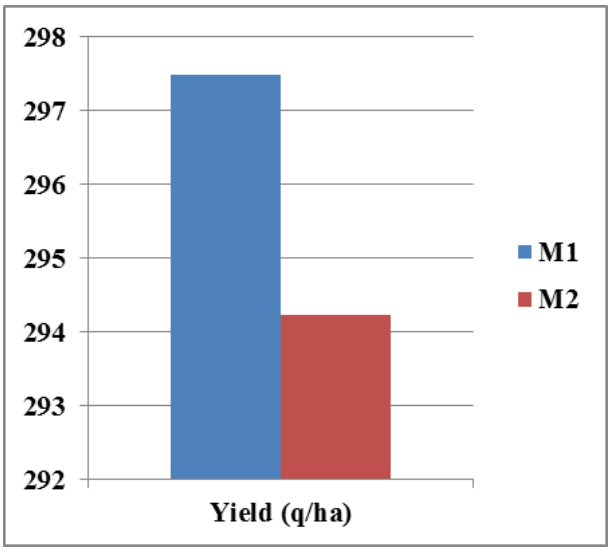
were also included in research. The potato variety Kufri Bahar sprouted tubers with optimum size (35-40g) treated with bio-fertilizer according to the treatments were planted at 60 cm row to row spacing and 20 cm plant to plant spacing. The calculated amount of organic manures as per the treatments was applied at the time of planting. Before the emergence of weeds and crop 7.5 t/ha (air dry basis) grass mulch was applied as per the treatments. First irrigation was given after the emergence of crop plants. One hand weeding and earthing up was done at 35 days after the planting of crop in necessary plots. The density of weeds was recorded before the hand weeding from two randomly selected quadrates (0.25 m^2) in each plot. The collected data were analyzed statistically with OPSTAT computer based software (Sheoran *et al.*, 1998) [9] and the means were separated by using LSD test.

Results and Discussion

The predominant weed species in the experimental field were: *Daucus carota, Rumax dentatus, Chenopodium album, Spergulla arvensis, Anagalis arvensis* and *Melilotus* spp. The density of different weed species was influenced significantly by mulching treatments (Graph 1). Mulching (M_1) significantly reduced the density and dry matter of all the weed species over the non-mulching (M_2) treatment, while organic treatments did not have any effect on number of weeds (Graph 3). Hidayat *et al.* (2013) [4] also reported the similar results in potato. This might be due the physical hindrance of mulching and reduced the germination and growth of weeds by reducing the light for breaking the dormancy of weed seed and photosynthesis rate of weeds. Among the manures and bio-fertilizer treatments, weed density was statistically similar in all the treatments, whereas dry matter of weeds influenced significantly.



Graph 1.



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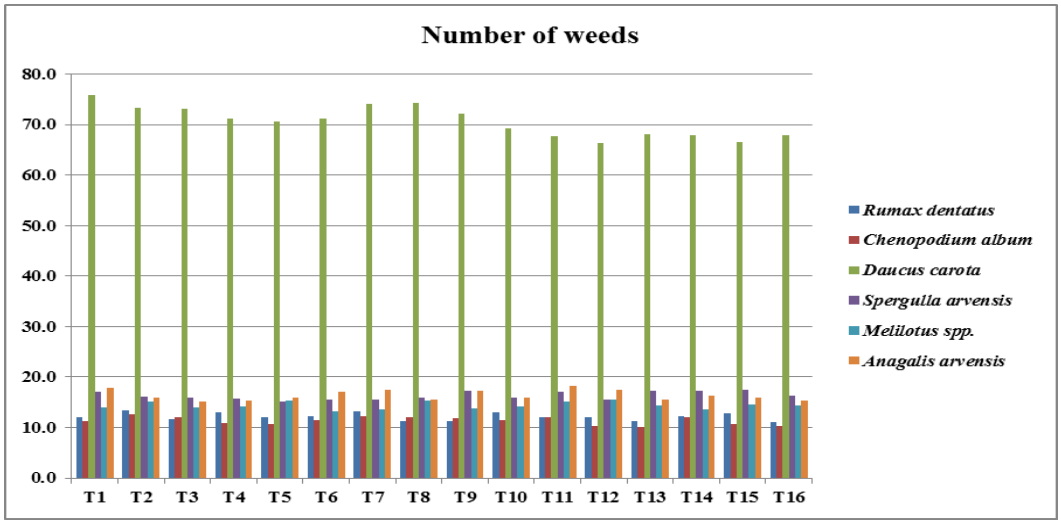

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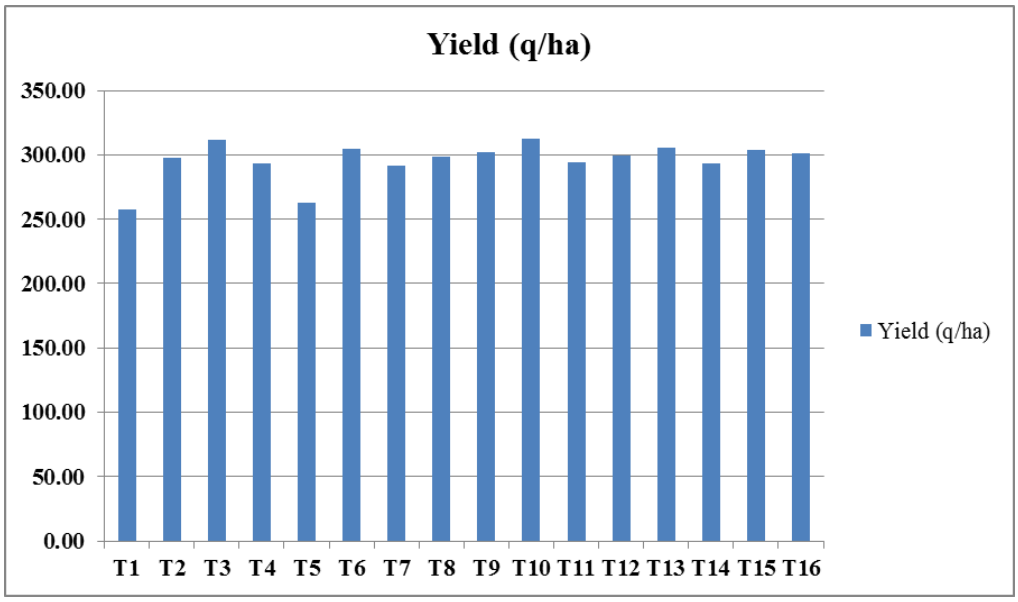
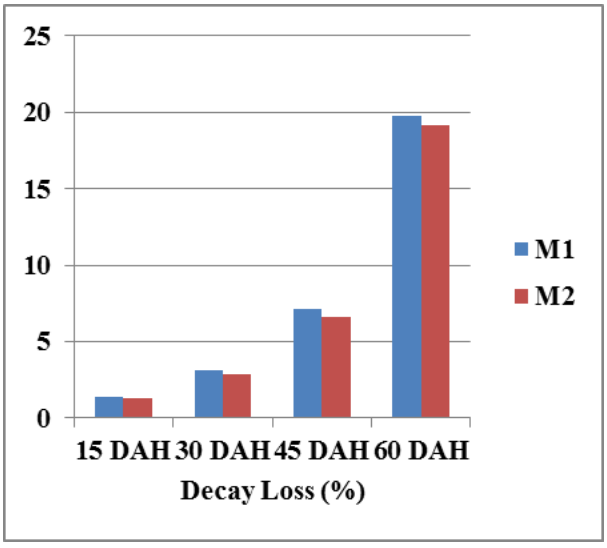
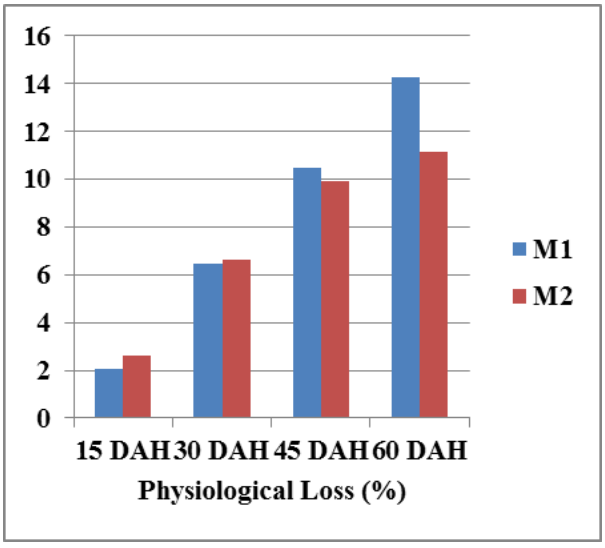


Graph 4.

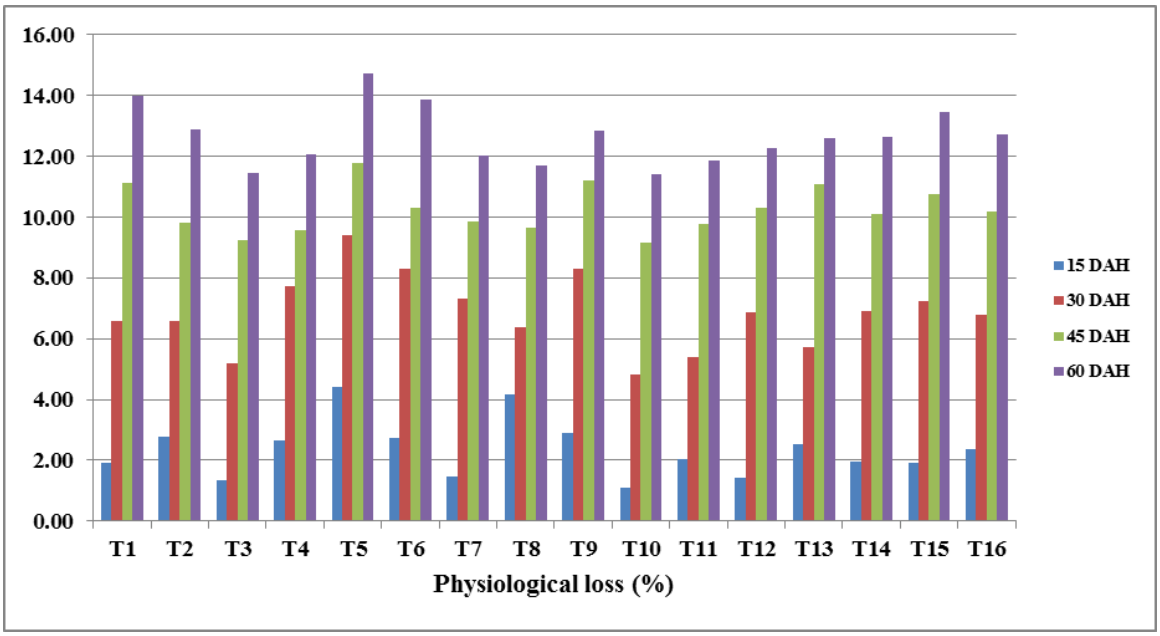
The pooled data of over two years presented in graph (2&4) clearly indicate that different treatments influenced the total yield of potato. The higher total yield (297.48 q/ha) was obtained with mulching treatment compared to non-mulching treatment (294.24 q/ha). The total yield was significantly increased by all manurial treatments over control but maximum yield increase was given by vermi-compost 6.0 t/ ha + Bio-fertilizer (T_{10}). This might be due to the better growth of plant and tuber under mulching, manure and bio-fertilizer treatments produced large size tuber than control. Mulching can be the addition of inorganic or organic material such as straw, cover crop residue or live plant to the soil surface to provide one or several ecosystem services such as enriching or protecting the soil, preventing pest establishment or enhancing crop yield. Due to maximum water retention in the soil and minimum growth of weeds the soils ensure the maximum nutrient uptake by the plants (Ahmad *et al.*, 2017) [1]. Verma *et al.* (2010) [10] reported that the treatment (Crop residues +Azotobacter+75% recommended dose of NPK) was found best among all treatments and gave highest number of tubers/ha, total tuber yield/ha. Similar effect of bio-fertilizers and vermi-compost on total tuber yield (q/ha) was reported by Kumar *et al.* (2013) [6] and Kuang (2008) [5] where the number of tubers per plant and yield were much greater in as compare to control.



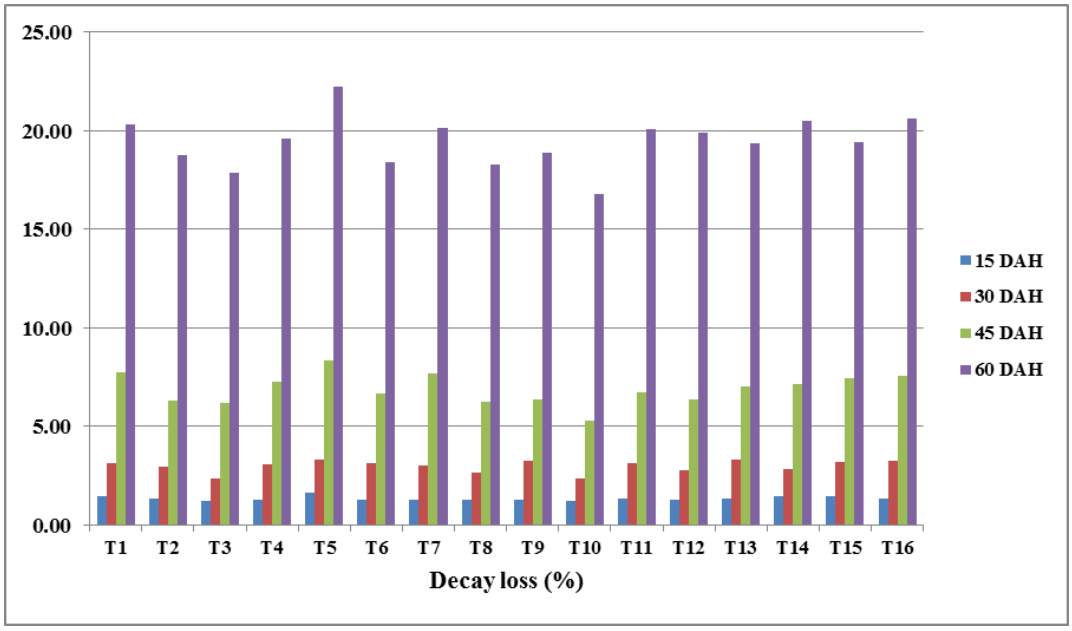
Graph 5.



Graph 6.



Graph 7.



Graph 8.

Physiological loss in potato tuber at ambient storage in jute bag was variable under different treatments (Graph 6&7). Significantly higher physiological loss at 15 DAH was recorded under non-mulch (2.63%) than mulching (2.08%) treatment. At 30, 45 and 60 DAH, mulching treatment recorded significantly higher physiological loss over non-mulching treatment. After 60 days of harvesting higher decay loss (19.75%) was observed from ulch treatment. The decay loss and physiological loss (60 DAH) was higher (22.26% and 14.74%) from the plants grown with T_5. Among the manures and bio-fertilizer treatments, maximum physiological loss was recorded with the application of bio-fertilizer alone at all observation stages. This might be due to the more water content under this treatment than other treatments. Vermicompost + BF recorded significantly lower physiological weight loss compare to the rest of the manure and bio-fertilizer treatments at all the observation stages. Decay loss in potato weight at ambient storage in jute bag was affected by different treatments (Graph 5&8). The decay loss was higher in the first year as compared to second year of experiment. In 2011, at the time of harvesting from February 13 to March 9, a total 42.7 mm rainfall was received. In addition to this, the minimum and maximum temperatures increased, which might have helped in increasing decay loss (%) of potato tubers at ambient room temperature. Significantly, more decay loss of tuber was recorded under mulching compare to the non-mulch treatment at all observation stages. Among the manures and bio-fertilizer treatments application of bio-fertilizer alone recorded significantly more decay loss over rest of the treatments followed by control treatment. This might be due to that the excessive initial plant growth and soil moisture in Mulching and BF treatments is conducive to the multiplication of many decay causing pathogens, and simultaneously, excessive moisture on crop canopy encourages the incidence of diseases. Minimum decay loss was found with the application of vermicompost + BF followed by vermicompost and FYM + BF treatments these treatment were significant lower in

decay loss compare to the control treatments. The mulching practice affects crop growth and development in various ways. It decreases the amount of water loss due to evaporation (Li *et al.*, 2013) [7] enhances soil water infiltration (Gan *et al.*, 2013) [3], distributes soil moisture again and therefore relieves water stress to some degree (Chakraborty *et al.*, 2008) [2]. Owing to many advantages, mulching improves crops yields both in quantity or quality (Wang *et al.*, 2008) [11], and increases water use efficiency.

Conclusion

By considering weed population and yield contributing characters the mulch material may be the most useful for potato cultivation. Mulches contribute to weed management in organic crops by reducing weed seed germination, blocking weed growth, and favouring the crop by conserving soil moisture and sometimes by moderating soil temperature. It can be summarized that use of bio- fertilizer along with mulching proved useful in increasing yield attributes of potato crop significantly compared to control.

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