

Effect of Mulching on Growth, Yield and Quality of Broccoli (*Brassica Oleracea* L. Var. *Italica*)- A Review

Sukhbir Kaur¹, Monisha Rawat*² and Khushboo Kathayat²

¹M. Sc. Student and ²Assistant Professor

Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara,
Punjab*Corresponding Author: monisha.22692@lpu.co.in

Abstract

Broccoli (*Brassica oleracea* L. var. *italica*) belongs to the family brassicaceae, having chromosome no. $2n=18$. It is also known as calabrese, Italian green or spear cauliflower. Morphologically, it is quite similar to cauliflower but plant forms head rather than curd. It is a store house of many phytonutrients. The demand of vegetables in the market is high and competition has forced the farmers to produce more and high quality vegetables. To increase the production per unit area, the use of mulch is one of the suitable methods. Mulching also helps to conserve moisture in the soil and recovers from the challenges that arise due to climate change. It also suppresses the weed growth and prevents soil erosion.

Keywords: Broccoli, moisture management, mulching, phytonutrients, weed growth

Introduction

Broccoli, commonly known as green cauliflower in India was introduced from the United States of America and Europe. Botanically known as *Brassica oleracea* L. var. *italica*, it belongs to the family Brassicaceae with chromosome number $2n=18$. It is an important member of cole group, having common progenitor, i.e., wild cabbage (*Brassica oleracea* L. var. *sylvestris*). In the 2nd half of 20th century, it was introduced in India. It is mainly of two types, green heading broccoli and purple sprouting broccoli. There are three commonly grown varieties of broccoli (i) the calabrese, most common and first cultivated, with large green heads and thick stalks, (ii) sprouting broccoli, with large number of heads and many thin stalks, (iii) romanesco broccoli has numerous small cone-shaped heads arranged in spirals and yellow-green in color. According to the color, three types of broccoli are cultivated i.e. green, purple and yellow. Sprouting type broccoli is more popular in India and its production stands at 4th place after cauliflower, cabbage and kohlrabi. It is mostly cultivated in the hills of H.P., Jammu Kashmir, U.P., Nilgiri hills and northern plains of India. The United States of America is the largest producer followed by Italy, Northern Europe and cooler region of Far East.

Broccoli is a vegetable full of nutrients. It is one of the low calorie vegetable and richest source of nutrients among cole crops due to its higher quantity of minerals, potassium, calcium, sodium, iron, vitamin A, B, C and K. It is low in carbohydrate (Fabek et al, 2012). Leaves of broccoli are rich source of vitamin A and carotenoids. Its flower head contain omega-3 fatty acid. It contains phytonutrients that are beneficial for our body such as thiocynates, sulforaphane, isothiocyanates and flavonoids like beta-carotene, lutein and zeaxanthin. It contains carbohydrates (5.5%), protein (3.3%), vitamin A (3500 IU), vitamin C (137 mg), vitamin B₁ (0.05 mg), vitamin B₂ (0.12 mg), calcium (0.80 mg) and phosphorus (0.79 mg). It has riboflavin (4.0 mg), calcium (2.5 mg) and ascorbic acid (2.0 mg) content which is more as compared to cauliflower (Hazra and Som, 1999). The American Society suggested the inclusion of broccoli in diet to reduce the risk of developing cancer. It also contains high amount of carotenoids, which prevent and decrease the risk of various human cancer, diabetes, heart diseases and high blood pressure. It helps in reducing the cholesterol level in body. In India, it is a new crop which is rich in vitamins and minerals, and also contains sulphoraphane compound that reduces the risk of cancer (Kalia, 1995). In 2016, the broccoli production was 25.2 million tonnes worldwide with China and India together accounting 73% the total production. In 2014, the US Department of Agriculture reported total broccoli production of 0.95 million tonnes. Due to the nutritional and medicinal value, its popularity among the people is increasing day by day and at present, it occupies an area of about 50 hectares. It is also a rich source of sulphoraphane (sinigrin) compound associated with reducing risk of cancer. It is marketed as fresh, frozen and also used in salads. The flower clusters and stalks are boiled or steamed, but these may also be eaten as raw. Its nutritional benefits are reduced, if the vegetable is boiled (Song & Thornalley, 2007).

Mulching is an important intercultural practice to get the quality produce. It is done widely during the winter season to prevent the soil from freezing. Mulches are of two types viz., organic and inorganic, depending upon the material used. Organic mulches include saw dust, compost, pine bark, lawn clippings, seaweed, mushroom compost, straw, bark chips, manure and waste papers etc. whereas, inorganic mulches include gravel, synthetic plastics of various colors (Unger, 1975) and thickness. Organic and inorganic mulches are used according to the crop need and it enhances moisture infiltration and reduces runoff. Organic mulch decomposes easily than inorganic mulch. In the cultivation of vegetables, mulches are commonly used to improve the soil health by protecting the crop from unfavorable factors and keep the growing condition of crop is better. It reduces soil and water erosion, maintains soil temperature and increases soil porosity. Application of straw mulch and grass mulch increases the available phosphorus and potassium in the soil and encourages the growth of beneficial soil microorganisms. Straw mulch is used in high temperature areas to keep soil temperature lower during the day and higher at night, and also protects the plant from temperature stress. Successful production of broccoli depends upon various factors such as fertilizers and moisture management which assures crop

production. Mulching helps to reduce weed growth, maintains soil temperature, moisture and also helps to produce healthier plant and increase vegetable yield.

Effect of mulching on Growth parameter

Islam et al (2014) conducted an experiment to find out the effect on growth parameters of broccoli by different mulch materials (M_1 = black polythene, M_2 = water hyacinth and M_3 = rice straw mulch) with M_0 = control. Plant height, number of leaves plant⁻¹, leaf length and leaf breadth of broccoli were affected significantly at 20, 40 and 60 DAT. The values for growth parameters were found higher in M_2 . Mohammed *et al.* (2016) conducted an experiment and found that plant height, leaf area, leaves number/plant, number of branches/plant increased as compared to control by mulching with black polyethylene. Thentu et al (2016) reported highest plant height (71.90 cm), number of leaves plant⁻¹ (38.51), plant spread (92.25 cm) with black polythene mulch treatment. This treatment was found superior to paddy straw mulch @ 5 t/ha and no mulch (control). Singh and Kumar (2017) conducted an experiment on broccoli by using black, silver and no mulch and observed highest plant height (78.6 cm) and maximum number of leaves plant⁻¹ (47) in black plastic mulch. Patle *et al.* (2018) studied the effect of irrigation and mulching on growth parameters of broccoli and found higher number of leaves/plant in mulched plot of drip and furrow irrigation. Number of leaves plant⁻¹, plant height and stem diameter was higher under both levels of mulching and irrigation.

Effect of mulching on yield parameter

Ali (2004) conducted a field experiment and found that maximum average yield (16.4 t/ha) was obtained from 220 kg N/ha with black polythene mulch. Faruque (2004) found highest average yield of 18.2 t/ha by using black polythene mulch along with organic and inorganic fertilizers and lowest yield was found in treatment without fertilizer and mulch. Hashem (2005) conducted an experiment to find out the effect of manuring and mulching on yield parameters of broccoli and found maximum yield (17.6 t/ha) from organic and inorganic fertilizers with black polythene mulch. Diaz- Perez et al (2010) conducted an experiment on broccoli and found the effect of mulching on total floret yield and individual floret weight and observed maximum result with the application of wheat straw mulch material and minimum in control. Kosterna (2014) carried out

an experiment to determine the effect of mulching on broccoli by using straw of rye, corn, rape and buckwheat and found that mulching with all kinds of straw increased yield as compared to plots without straw. The highest yield was obtained from plot mulched with buckwheat straw as compared with other straw material.

Islam et al (2014) conducted an experiment to find out the performance of different mulch material on yield of broccoli and found that the plot covered by mulch gave higher yield than non mulched plot. Among four levels of mulching (M_0 = control, M_1 = black polythene, M_2 = water hyacinth and M_3 = rice straw) maximum yield per plant (0.44 kg) was recorded in M_2 (water hyacinth) treatment while minimum (0.37 kg) was measured in M_0 (control) treatment. Mulching also affected total yield per hectare of broccoli. The maximum yield/ha (14.58 t) was recorded in M_2 (water hyacinth) and minimum (12.23 t) in M_0 (control).

Thentu et al (2016) carried out an experiment on broccoli and found out that maximum curd diameter (14.36 cm) and curd yield (17.89 t ha^{-1}) was obtained with black polythene mulch treatment which was found superior to paddy straw mulch (5 t ha^{-1}) and no mulch (control). Singh and Kumar (2017) conducted an experiment on broccoli by using two colored plastic mulch viz., black, silver and non-mulch. The maximum number of curd/plant (14) were found in black polythene mulch followed by silver colour and non-mulched treatment. Highest broccoli yield 2475 kg/acre was recorded in black colour mulch followed by silver colour.

Effect of mulching on quality parameters

Regar et al (2018) conducted an experiment to find out the quality characters of sprouting broccoli during Rabi season 2016-2017. The experiment had 16 treatment combinations with 4 levels each of mulching (mustard straw, saw dust, black polythene sheet and control) and biofertilizer (PSB, Azotobacter, PSB + Azotobacter and control) with 3 replications. The TSS(9.10%) and vitamin C content (81.00 mg/100 g) in curd was found maximum in black polythene mulch treatment. The quality attributes were minimum in control. In treatment M_3 (black polythene mulch), TSS content was 60.49% and vitamin C content was 23.36% higher over the control. Kosterna (2014) carried out an experiment to find the quality of broccoli and

observed highest dry matter content of 11.06% from rye straw mulched plots and lowest from rape straw mulched plots (6.86%). Soil mulched with buckwheat straw gave highest ascorbic acid content (85.42 mg/100 g).

Saloom and AL- Sahaf (2016) carried out an experiment to find out the effect of organic and mineral fertilization and soil mulching on quality characters of broccoli. He found that treatment M₁ with black polythene mulch have higher TSS (8.83%) and vitamin C content (89.62 mg/100 g) in curd while minimum in control (without mulch).

Conclusion

Mulching had great impact on all attributes like growth, yield and quality of broccoli. Findings shows that mulching suppresses weed growth, conserves soil moisture and increases production. Different mulching materials like black polythene mulch, straw mulch, sawdust mulch and water hyacinth mulch etc. gave best results during different experiments over control as it created better soil environment by checking evaporation loss and fall of soil temperature during winter which might have led to better moisture utilization and lesser competition of weeds. Therefore, the use of mulch is a better option in a water demanding crop like broccoli for reducing weed population, conserving soil moisture and enhancing crop production efficiency by many folds.

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