

# Different mulch material on growth, performance and yield of garlic: A Review

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## Abstract

Garlic (*Allium sativum* L.) is an ancient crop grown and used for various purposes for human being. From many techniques to increase yield of garlic using mulch on garlic plots is the easiest and fastest method. Mulch protects the plants from loss of soil moisture by wind, soil evaporation, reduces the irrigation requirements and improved chemical and physical properties of the soil. Mulch increases garlic plant growth and development, increases yield of garlic, promotes earlier harvest of the crop, reduces fertilizer leaching and protects the surface of the soil against unfavorable factors. The beneficial effect of mulch not only on yield of garlic, but also extend to quality of clove, to create congenial condition for growth this include regulating soil moisture and temperature, reduce salinity and weed control. Thus this review is focused on to summarize information on different mulch material and effect of different mulch material on yield and yield component of garlic.

## Keywords

Organic Mulch, Inorganic Mulch, Garlic Yield

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## 1. Introduction

Garlic (*Allium sativum* L.) is an ancient crop that originated in Central Asia. It has been grown for culinary, medicinal, and religious purposes for several millennia. Garlic is grown for its edible bulbs, which are composed of a number of cloves. The bulbs can be eaten fresh, cooked in various ways, processed into a dehydrated product, or saved for seed to be planted later. Garlic leaves and flower stalks are also edible [1]. Garlic is responsive to temperature and photoperiod for proper clove and bulb formation, and subsequent scape development of some varieties. Because of this, significant differences in yield can occur, even with plantings of the same variety.

Mulching is an agricultural and horticultural technique in which very useful to conserve moisture, to improve the fertility and health of the soil, to reduce weed growth, to enhance the visual appeal of the area. Mulch may be permanent (e.g. plastic sheeting) or temporary (e.g. bark chips). It may be applied to bare soil, or around existing plants. Mulches of manure or compost will be incorporated naturally into the soil by the activity of worms and other organisms [2].

Garlic is known to be thermo-photo-sensitive crop and its vegetative growth and bulb development are greatly influenced by growing environment [1] and [3]. Manipulation of growing environment by cultural practices has the potentiality to improve yield.

Therefore from cultural practices, mulching is one of the good cultural practices for the favorable manipulation of microclimate. The beneficial effect of mulch not only on yield of garlic, and also quality of clove, to create congenial condition for growth this include regulating soil moisture and temperature, and also on reduce salinity and weed control weed control. Thus this review is focused on to summarize information on different mulch material and effect of

different mulch material on yield and yield component of garlic.

## 2. Climatic Requirement and Production Status

Garlic grows best in areas with comparatively mild climate. It requires cooler weather during the early stages of growth and dry atmosphere with moderately high temperature for maturation. It can be grown from sea level to over 1,000 feet above sea level. An area with Type 1 climate that is dry from November to April is best for commercial production of garlic. Garlic can be grown in several types of soil. It grows best in sandy loam and silty loam to clay loam with pH of 5.66.8 [4].

In Ethiopia, next to onion, garlic is the most widely used crop among cultivated *Allium* species. Garlic is an important source of income for farmers and also source of foreign currency in Ethiopia [5]. In Ethiopia, it is grown over an area of 21,258.43 hectares, with an annual production of 2,225,479.30 quintals per hectare, and productivity of 10.47 t/ha respectively [6].

Garlic is one of the most important bulb crops produced by small and commercial growers both for local use and for export [5] in Ethiopia. It is spread throughout Ethiopia being cultivated under irrigated as well as rain fed condition mainly in the mid and high lands of the country. It is also being cultivated both for home consumption and as a cash crop [5].

### 2.1. Selecting the Right Mulch

Many materials can be used for mulching. Before choosing mulch, however, consider how you will use it. Summer mulches are in place during the growing season and are used primarily for vegetables. Their roles are to retain moisture, reduce weed growth and moderate soil temperatures. Summer mulches are often left in place through the winter to reduce erosion. For perennial plants, they can also be supplemented by winter mulches. On the other hand winter mulches used primarily to protect from severe winter temperatures and frost heaving are called winter mulches. They are laid down in late fall and serve as insulation during the winter [7].

Another consideration is choosing the right mulch for the location. Black plastic and straw are commonly used in vegetable gardens or small fruit plantings. Wood chips, bark chunks, and pine needles are appropriate mulches for shrub beds or around trees. Fine mulches, such as bark granules, wood shavings, cocoa shells, and buckwheat hulls, are attractive when used in annual or perennial beds. Fine gravel or crushed stone mulches look most natural when used in rock gardens. Other considerations in selecting mulch are cost and availability [8].

## 3. Types of mulching materials

### 3.1. Organic mulches

Organic mulches are derived from plant and animal materials such as straw, hay, peanut hulls, leaf mold, compost, sawdust, woodchips, shavings and animal manures. To achieve optimum advantage from the organic mulch, the mulch should be applied immediately after germination of crop or transplanting of vegetable seedling [9]. Organic mulch are efficient in reduction of nitrates leaching, improve soil physical properties, prevent erosion, supply organic matter, regulate temperature and water retention, improve nitrogen balance, take part in nutrient cycle as well as increase the biological activity.

Over time, organic mulches will decompose and become part of the soil. This is a great advantage, because this decomposition adds organic matter to soil, helping the soil to better retain water and nutrients giving you healthier plants. This means, however, that organic mulches will have to be replenished from time to time [7].

**Grass Clipping:** This is one of the most abundantly and easily available mulch materials across the country. It provides nitrogen to the soil, if incorporated fresh. However, application of green grass in rainy season may result into the development of its own root system which will be detrimental to plant growth [10].

**Straw:** Straw makes a good winter mulch or mulch for the vegetable garden. It is inexpensive, suppresses weeds, conserves moisture, and insulates well. Among organic mulching materials, straw has a long life in comparison to other mulches (grasses, leaves and leaf mould) [7].

**Newspaper:** Newspaper mulching helps to control weeds and also add little organic matter in soil. One to two cm thick sheet of newspaper should be used and edges should be fastened with materials like pebbles gravels etc. keep wet or cover with bark or other mulch; best used between vegetable rows [11].

**Dry leaves:** Leaves, an easily available material, are good for mulching. Though leaves are good for protecting

dormant plants during winter by keeping them warm and dry but due to lightweight they may be blown away even by light wind. To counter this problem, it requires anchoring which can be done with stones, chipped bark and covering with net or some form of sheet [10].

**Bark clippings:** These are good mulch materials as they are long lasting and allow proper aeration to the soil underneath. Hardwood bark clippings contain more nutrients than softwood but bark clippings are not easily and abundantly available, and some bark products may cause phytotoxicity [10].

**Sawdust:** Sawdust is often readily available and may be helpful in acidifying the soil around rhododendrons and other acid loving plants. Sawdust is a poor choice in most situations, however, as weed seeds easily sprout in the mulch. It also tends to cake, making it harder for water to soak into the ground. Sawdust is low in nitrogen, so it robs nitrogen from the soil as it decomposes. Therefore, more nitrogen fertilizer may be needed. A 3 to 6 inch layer of sawdust does work well, however, for mulching pathways [7].

### **3.2. Inorganic mulches**

Inorganic mulch includes plastic mulch and accounts for the greatest volume of mulch used in commercial crop production. The plastic materials used as mulch are poly vinyl chloride or polyethylene films. Owing to its greater permeability to long wave radiation it can increase temperature around the plants during night in winter. Hence, polyethylene film mulch is preferred as mulching material for production of horticultural crops [2].

Plastic mulch was first used for vegetable production in the 1960s and more growers are using plastics each year because of the advantages they provide. They are used commercially for both vegetables and small fruit crops. Vegetable crops that are well suited to production with plastic mulch are typically high value row crops [12].

**Plastics:** Plastic works well for keeping weeds down and retaining soil moisture. Although it prevents water from leaving the soil, it also prevents it from entering the soil making it unsuitable for landscape plantings that depend on rainfall for their water. Plastic is best reserved for vegetable gardens where irrigation systems can be placed under the plastic and bare spaces left between rows to allow water entry into the soil [7].

**Photo-degradable plastic mulch:** This type of plastic mulch film gets destroyed by sun light in a shorter period.  
**Bio-degradable plastic mulch:** This type of plastic mulch film is easily degraded in the soil over a period of time.

**Colour of film:** Soil environment can be managed precisely by a proper selection of plastic mulch composition, colour and thickness. Films are available in variety of colours including black, transparent, white, silver, blue red, etc. But the selection of the colour of plastic mulch film depends on specific targets. Generally, the following types of plastic mulch films are used in horticultural crops [10].

Plastic mulch gave satisfactory weed control without any application of herbicides [13]. Black and white polythene mulch or organic mulch are a reasonable expense and conserve soil moisture [14]. Polythene mulch also increases soil temperature and moisture especially in early spring. These synthetic mulches reduce weed problems and certain insect pests and also stimulate higher crop yields by more efficient utilization of soil nutrients [15].

Plastic mulches are very effective as mulches for evaporation controls provided cost is not limiting factors. Both, black and transparent films are generally used for mulching. Advancement in plastic chemistry has resulted in development of films with optical properties that are ideal for a specific crop in a given location [16]. Mulching with organic and inorganic mulch is a well-established technique for increasing the profitability of many horticultural crops. Such effects are mainly contributed to the capacity of mulch to conserve soil moisture [17].

## **4. Role of Different Mulch on Growth, Performance and Yield Garlic**

Garlic is sensitive to moisture stress and high temperature and found about 60% reduction in yield when it was associated with water stress [18]. [19] compared garlic produced on bare soil during the winter and wheat (*Triticum aestivum*) straw mulch in the spring to black plastic. Black plastic provided greater winter protection for garlic (95% survival rate) compared with bare soil (85% survival rate). Greater marketable weights and bulb diameters resulted when garlic was grown in black plastic compared with the bare soil/wheat straw mulch treatment.

According to [20] the tallest plant, maximum number of leaves, highest fresh weight of leaves, highest diameter of bulb, highest dry weight of bulb and maximum bulb weight were obtained from black polyethylene mulch followed by water hyacinth and straw mulches respectively. They conclude that water hyacinth and black polyethylene mulch were suitable for increasing garlic production. [21] Indicated that the number of leaves/plant, weed growth and cured bulb yield responded significantly to mulching and based on their results for optimum bulb yield in garlic proposed the

using of 9 t/ha mulch.

According to [22] reported maximum bulb weight, higher yield per plot and per hectare was recorded from water hyacinth and straw mulches respectively than unmulched plots. Similarly, Plants treated with any kind of mulches under study significantly increased plant height, number of leaves per plant, length of leaf, length of pseudo stem, number of roots per plant, clove number per bulb, 100 clove weight, bulb and neck diameter over the control [23]. These mulches significantly influenced both on chlorophyll-a & chlorophyll-b contents.

As studied by [24] maximum number of cloves, maximum bulb weight, maximum yield per 10 bulbs was observed from straw mulches followed by plastic and sawdust mulch and control. Individual comparison of the duration of mulches showed that plants grown for the whole season under any mulch produced highest yield than those which have a one month mulching period. Although the straw and plastic mulches both gave maximum yield of garlic crop as compared to straw dust but straw mulch overall performed better than others. It is also cheaper and organic in nature.

[25] reported soil mulching increased the quality and the bulb yield of garlic. The increase in yield was up to 140 %. [26] reported that use of mulches not only increase bulb yield but also improve some quality indices such that ash percent, TSS and vitamin C in garlic samples. [27] Investigate use of mulches showed significant variation on all parameters. The highest plant height, number of leaves, fresh weight of bulb, dry weight of bulb, bulb diameter, number of cloves per bulb, yield per plot was achieved from water hyacinth condition followed by straw mulch. As studied by [28] the effects of mulching by transparent polyethylene and net polyethylene on the growth of garlic. Plant height and leaf number of garlic were highest at transparent polyethylene treatment and this treatment also promoted the number of cloves. [29] reported that different mulches had significant effects on growth and yield of garlic. Natural mulch better than synthetic mulch, water hyacinth mulch produced the tallest plant with higher number of leaves and roots per plant, higher fresh and dry weight of bulb, length of bulb and highest yield per hectare followed by black polyethylene mulch and saw dust. They conclude that biomass production and growth rates can be manipulated by the application of natural and synthetic mulches in garlic. Among the mulches used in this study, dry water hyacinth mulch emerged as the most efficient in the enhancement of growth and dry matter production. Natural mulches that are abundantly available and cheaper were found better than synthetic mulches. Mulching showed overall better performance than non-mulch treatments. Mulches conserved more soil moistures enhancing vegetative growth and yield contributing characters [20]. Use of different kind of mulches showed a significant effect on plant height, leaf length, leaf number and days to maturity. Maximum height was recorded in black polyethylene mulch followed by the grass mulch. More leaf number and late maturity day were also recorded in treatments treated with black polyethylene mulch followed by grass mulch [30].

## 5. Conclusion

The beneficial effects of organic and synthetic mulches for crop production have been widely discussed by many researchers. Researches had shown various beneficial effects of mulch on horticultural crop through soil and water conservation, enhanced soil biological activity and improved chemical and physical properties of the soil, reduce weed growth. In addition mulches increases plant growth and development, increases quality produce and yield, promotes earlier harvest of the crop, reduces fertilizer leaching, and protects the surface of the soil against unfavorable factors. Specifically, soil mulching (covering) favorably affected the quality and bulb yield of garlic, there is highly significant difference in total performance and yield between mulched and un mulched garlic plants.

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