

# Effect of Different Types of Mulches and Their Duration on the Growth and Yield of Garlic (*Allium Sativum* L.)

M. JAMIL<sup>1</sup>, M. MUNIR, M. QASIM, JALAL-UD-DIN BALOCH AND K. REHMAN

Faculty of Agriculture, Gomal University, D.I. Khan, Pakistan

<sup>1</sup>Corresponding author's e-mail: [jamil\\_marwat@hotmail.com](mailto:jamil_marwat@hotmail.com), [shahmir3rd@yahoo.com](mailto:shahmir3rd@yahoo.com)

## ABSTRACT

In this study, the effects of different type of mulches (plastic, straw & sawdust, excluding, control) and their duration (one month & whole season) on the growth and yield of garlic were observed in a field experiment. Straw and plastic mulches increased the bulb yield and yield components, irrespective of their duration. Straw mulch is recommended for the garlic production based on better overall performance than the others and also for being cheaper and organic in nature.

**Key Words:** Garlic; *Allium sativum* L.; Growth and yield; Mulches.

## INTRODUCTION

In soil management relationships, mulching has been reported to influence organic matter content, activity of microorganisms, availability of soil nutrients, control of erosion and soil compaction (Stowell, 2000). Most mulches in common usage are some types of organic material. They contribute to the humus content of soil where they undergo decomposition (Hassan, 1999). Soil microorganisms are active in the plant residue types of mulches especially at the soil surface where both the soil and mulch are moist. The nitrogen-fixing bacteria require nitrates in their metabolism while breaking down organic matter. Plastic mulch has been reported to increase output and farm revenue (Mugalla *et al.*, 1996). On the other side, the straw-mulch system was shown to result in annual yields from continuous wheat that were equivalent to yields in alternate years with the conventional fallow wheat system, thereby doubling wheat production in this dryland region (Amir & Sinclair, 1996).

Tomatoes grown in commercially available black paper mulch show similar yields and earliness to tomatoes grown in black polyethylene mulch, even though the latter results in slightly higher soil temperatures (Anderson *et al.*, 1995). It is also observed that as the colour of the system changed from black to white, soil temperatures under the mulch decrease (Graham *et al.*, 1995). Marketable yield of beans increases by black spray-on mulch over plants grown with white spray-on mulch (Russo, 1995). However, temperature increase often resulting in acceptable plant stands with plastic mulch (Cavero *et al.*, 1996). Rubeiz and Freiwat (1995) reported that early production in tomato is enhanced by black plastic mulch, while the rowcover alone can have a negative effect on yield.

Mulched treatments generally showed significantly greater total uptake of N, P and K than corresponding unmulched ones (Acharya & Sharma, 1994). Tomato fruit and leaves N levels were higher with the cover-crop

mulches than with black polyethylene mulch (Abdul-Baki *et al.*, 1996). Aliudin (1986) mulched plots of garlic cv. Lumbu Jijau with rice straw, rice husks, panicum distachyum, Brachiaria distachya, hay and dried grass weeds yielded 9.18, 7.80, 8.28 and 7.42 t ha<sup>-1</sup>, respectively as compared to 7.58 t ha<sup>-1</sup> in unmulched plots. Mansour and Hemphill (1987) stated that spunbonded polyester gave the best results followed by perforated polyethylene and silted polyethylene regarding the plant height of garlic cv. Ishikura. Mulching with polyethylene film enhances the bulbs yields, maturity of plants and growth rate, bulb weight, number of cloves per bulb and rate of secondary growth (Chung, 1987). Polyethylene film mulched garlic survived better than non-mulched garlic and the bulb yields were 50% higher (Shin *et al.*, 1988). Keeping in view the importance of mulches, an experiment was conducted to observe the effect of different types and duration of mulches on the yield and yield components of garlic.

## MATERIALS AND METHODS

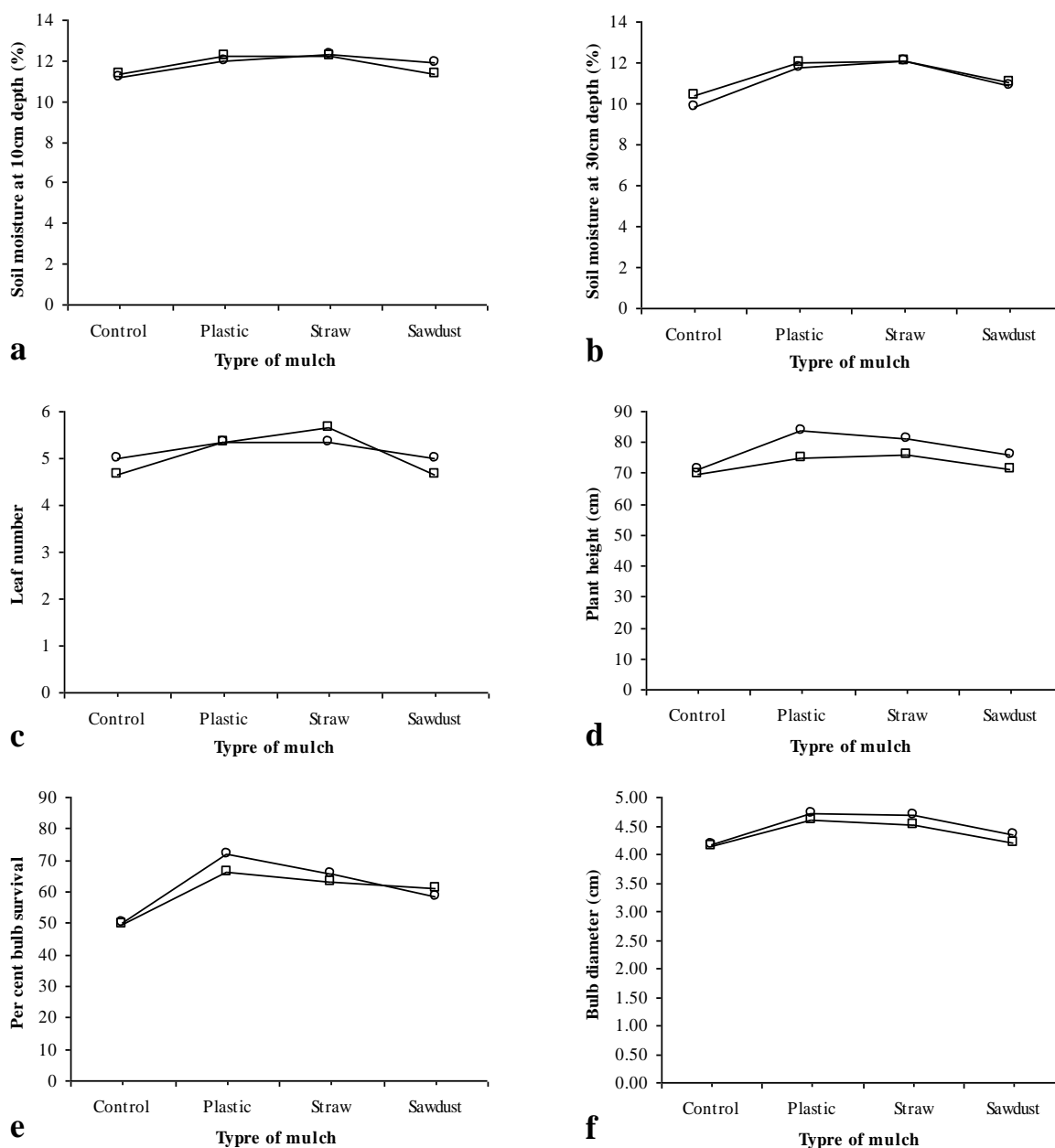
The experiment was conducted at Faculty of Agriculture, Gomal University, D.I. Khan, Pakistan, during spring 2003. It was laid out on two-factorial Randomized Complete Block Design (mulches & their duration) with three replications. Three mulches (plastic, straw & sawdust) excluding a control treatment were either used for one month or whole season. The variety "Bannu Local" of garlic was used in this experiment. All cultural practices were adopted as recommended. The observations recorded during these studies were, moisture at 2 and 6 inches deep soil, plant height, leaf number, percent bulb survival, bulb diameter and weight, number of cloves per 10 bulbs, neck diameter, and yield. Data were analysed by using the analysis of variance technique and regression analysis of GENSTAT-5, Release 4.1 (Lawes Agricultural Trust, Rothamsted Experimental Station, U.K.).

## RESULTS AND DISCUSSION

A non-significant effect was observed on moisture conservation of any of the treatment at any duration or depth (Fig. 1 a, b). Almost all treatments including control have more or less similar percentage of moisture percentage at 10 cm depth, which might be due to the exposed surface of plot in whole night and imposition of excessive dew on

the top soil level. Leaf numbers at harvest were not significantly increased by the type and duration of mulches (Fig. 1c). However, approx. 4-6 leaves were counted in all treatments which showed that this parameter is cultivar dependent. Plants without mulch (control) were approximately 6 and 13 cm smaller than the plastic and straw mulches which were kept for one or whole season respectively (Fig. 1d). However, plants under plastic mulch

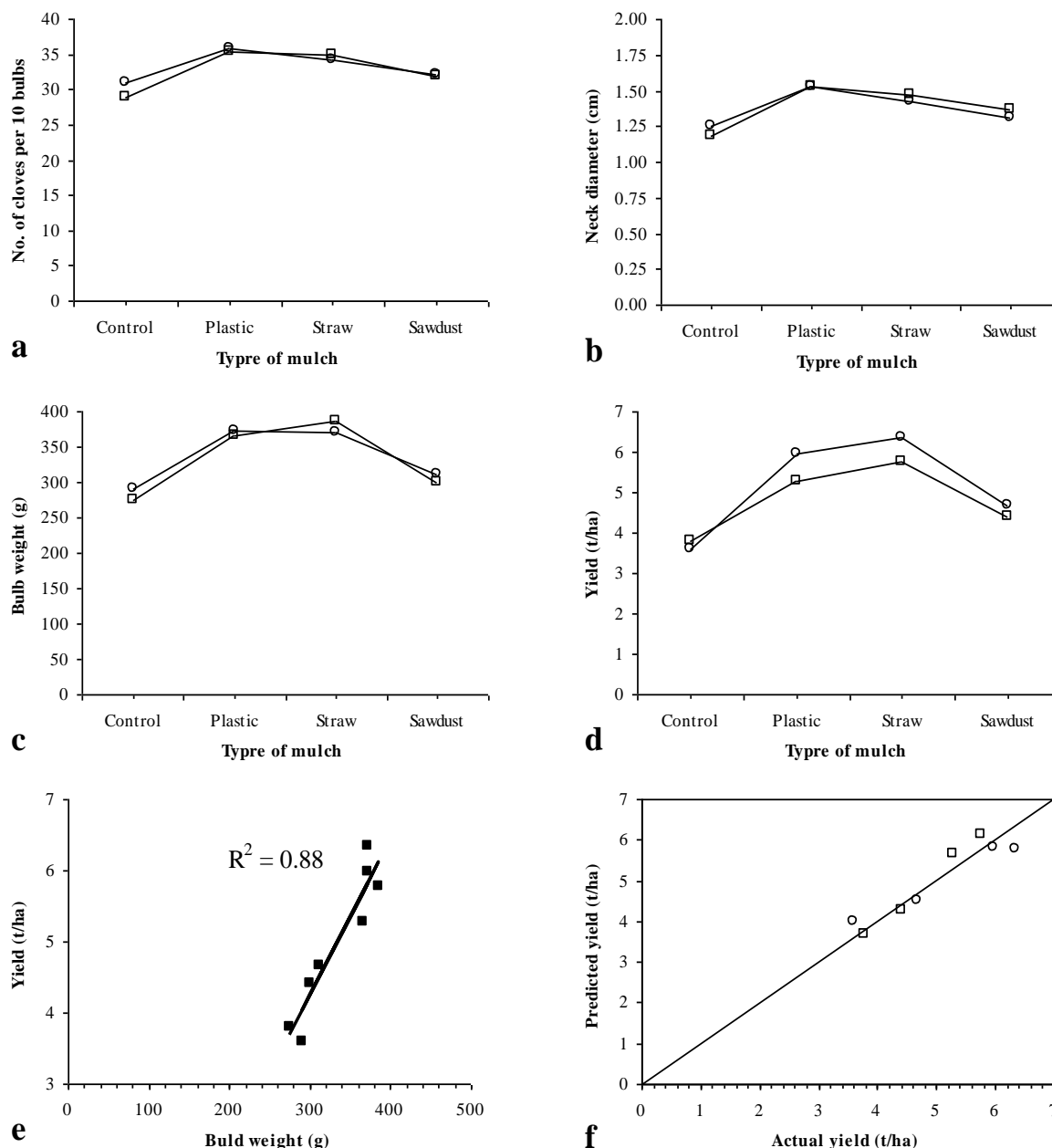
**Fig. 1.** Effect of different type (plastic, straw, sawdust, and control) and duration [one month (□) and whole season (○)] of mulches on (a) soil moisture content at 10cm soil depth, (b) soil moisture content at 30cm soil depth, (c) leaf number, (d) plant height (cm), (e) percent bulb survival, and (f) bulb diameter (cm)



had maximum size than the other treatments. Similarly, the duration of mulch also affect this parameter significantly, as the whole season mulch duration increased plant height in all treatments. Plant attained maximum height under mulches, particularly in plastic mulch, which might be due to the increased soil temperature (Tuli & Yesilsoy, 1997). Chung (1987) also reported that growth rate is always accelerated under polyethylene mulch. Maximum bulbs

survival percentage (71.83) was observed in plastic mulch used for the whole season followed by straw (65.59%) mulch, whereas it was minimum (50%) in control plots (Fig. 1e). These results are coincide with the findings of Shin *et al.* (1988) who reported that garlic plants under polyethylene film survived better than control. A significant difference ( $P < 0.05$ ) was found in bulb diameter of various types of mulches at both duration (Fig. 1f). Although a

**Fig. 2.** Effect of different type (plastic, straw, sawdust, and control) and duration [one month ( $\square$ ) and whole season ( $\circ$ )] of mulches on (a) No. of cloves per 10 bulbs, (b) neck diameter (cm), (c) bulb weight (g), and (d) yield (t/ha). Graph-e is showing the fitted model,  $\text{Yield} = a + bW$  at 6 d.f. Where  $W$  is the bulb weight. Graph f is showing the relationship between the actual yield against those fitted by the model. The solid line is the line of identity



comparison between two durations (one month & whole season) showed a non-significant difference. Plants grown under whole season mulches produced slightly bigger bulbs. The diameter of bulbs was maximum (4.71 cm) in plastic mulch followed by straw mulch (4.69 cm) while it was minimum in control and sawdust mulch i.e., 4.18 and 4.33 cm, respectively. This revealed that plants were more efficient when top soil temperature and moisture was higher under plastic and straw mulches.

A statistically non-significant effect of mulches and their duration was observed on number of cloves per 10 bulbs (Fig. 2a). However, maximum number (35) of cloves per 10 bulbs was counted in plastic and straw mulches whereas approx. 30-32 cloves were counted in plant under sawdust mulch and control. Chung (1987) counted maximum number of cloves from polyethylene mulch and recorded a similar observation. Results also revealed that different type of mulches and their duration have also non-significantly affected the neck diameter (Fig. 2b). It was maximum in plastic mulch (1.53 cm) followed by straw mulch (1.47 cm) and sawdust mulch (1.37 cm) while was minimum in control (1.18 cm). A very slight difference was noted between the duration of mulches. Bulb weight was significantly ( $P<0.05$ ) affected by different type of mulches (Fig. 2c). Maximum bulb weight (385.9 g) was observed in straw mulch followed by plastic (373 g) and sawdust (311.77 g) mulch while minimum bulb weight (274.8 g) was measured in control plots. A slight but non-significant difference was also found in the duration of mulch. Chung (1987) studied only polyethylene mulch and therefore reported that this type of mulch significantly enhanced bulb weight of garlic. Yield data revealed a significant ( $P<0.05$ ) effect of different type of mulches and their duration (Fig. 2d). Maximum yield was obtained from those plants which were grown under straw mulch ( $6.35 \text{ t ha}^{-1}$ ) followed by plastic ( $5.98 \text{ t ha}^{-1}$ ) and sawdust ( $4.67 \text{ t ha}^{-1}$ ) mulches while minimum yield ( $3.59 \text{ t ha}^{-1}$ ) was obtained from control plots. 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. The results showed a similarity to the work done by Alliudin (1986). Amir and Sinclair (1996) also obtained similar results by using straw mulch for wheat crop but Anderson *et al.* (1995) recorded highest yield of tomato when used either black paper or black polyethylene mulches. Similarly Shin *et al.* (1988) obtained much better yield of garlic with polyethylene mulch. The fitted relationship (Fig. 2e) describing the effects of bulb weight ( $W$ ) on the yield of garlic can be written as:

$$\text{Yield} = -2.31(\pm 1.09) + 0.02(\pm 0.0032) W \quad (R^2 = 0.88, \text{d.f. } 6)$$

The values in parenthesis are the standard errors of the regression coefficients. Therefore, bulb weight had significant ( $P<0.05$ ) effect on the yield per hectare. Fig. 2f compares the actual yield obtained versus the fitted

relationship.

## CONCLUSIONS

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. Therefore, straw mulch is recommended for better garlic production in the agroclimatic conditions of Dera Ismail Khan.

## REFERENCES

- Abdul-Baki, A.A., J.R. Teasdale, R. Korcak, D.J. Chitwood and R.N. Huettel, 1996. Fresh-market tomato production in a low-input alternative system using cover-crop mulch. *Hort. Sci.*, 31: 65-9
- Acharya, C.L. and P.D. Sharma, 1994. Tillage and mulch effects on soil physical-environment, root-growth, nutrient-uptake and yield of maize and wheat on an alfisol in north-west India. *Soil and Tillage Res.*, 32: 291-302
- Alliudin, 1986. Effect of soil tillage and application of mulch on yield of field grown garlic. *Bull. Penelitan Hort.*, 14: 23-7
- Amir, J. and T.R. Sinclair, 1996. A straw mulch system to allow continuous wheat production in an arid climate. *Field Crops Res.*, 47: 21-31
- Anderson, D.F., M.A. Garisto, J.C. Bourrut, M.W. Schonbeck, R. Jaye, A. Wurzberger and R. DeGregorio, 1995. Evaluation of a paper mulch made from recycled materials as an alternative to plastic film mulch for vegetables. *J. Sustainable Agric.*, 7: 39-61
- Cavero, J., R.G. Ortega and C. Zaragoza, 1996. Clear plastic mulch improved seedling emergence of direct-seeded pepper. *Hort. Sci.*, 31: 70-3
- Chung, H.D., 1987. Effect of polyethylene film mulching, sulphur application and different levels of nitrogen and potassium on growth, flower stalk elongation, bulbing and leaf tip yellowing of garlic cv. Euisung. *J. Korean Soc. Hort. Sci.*, 28: 1-8
- Graham, H.A.H., D.R. Decoteau, D.E. Linvill, 1995. Development of a polyethylene mulch system that changes color in the field. *Hort. Sci.*, 30: 265-9
- Hassan, M.J., 1999. Effect of soil moisture management and nitrogen levels on growth and yield of garlic. *M.Sc Thesis*, Department of Horticulture Bangladesh Agricultural University, Mymensingh, Bangladesh
- Mansour, N.S. and D.D. Hemphill, 1987. Bunching onion response to three floating row covers. *Hort. Sci.*, 22: 318-9
- Mugalla, C.L., C.M. Jolly and N.R. Martin, 1996. Profitability of black plastic mulch for limited resource farmers. *J. Prod. Agric.*, 9: 283-8
- Rubeiz, I.G. and M.M. Freiwa, 1995. Row cover and black plastic mulch effects on tomato production. *Biol. Agric. Hort.*, 12: 113-8
- Russo, V.M., 1995. Bedding, plant-population, and spray-on mulch tested to increase dry bean yield. *Hort. Sci.*, 30: 53-4
- Shin, K.H., J.C. Park, K.S. Lee, K.Y. Han and Y.S. Lee, 1988. Effects of planting dates and bulb size on the growth and yield of cv. Namdo garlic. *Res. Rep. Rural Develop. Admin., Hort.*, 30: 41-52
- Stowell, B., 2000. Organic kiwifruit production-maintaining soil fertility and yields. *Kiwifruit*, 139: 18-21
- Tuli, A. and M.S. Yesilsoy, 1997. Effect of soil temperature on growth and yield of squash under different mulch applications in plastic tunnel and open-air. *Turkish J. Agric. For.*, 21: 101-8

(Received 12 December 2004; Accepted 22 May 2005)