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EFFECT OF DIFFERENT MULCHES AND HERBICIDES ON POTATO AND ASSOCIATED WEEDS

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ABSTRACT

An experiment was conducted in 2008 at the University of Agriculture, Peshawar in RCB design. The treatments included in the experiment were Roundup 480 SL @ 0.47, Sencor 70WP @ 0.75 kg a.i. ha^{-1}, plastic mulches (both black and white), organic mulches (wheat straw @ 5 t ha^{-1} and saw dust @ 6 t ha^{-1}), a hand weeding and a no weeding treatment. Highest fresh weed biomass of 130.9 g m^{-2} was found in weedy check which was statistically at par with saw dust treatment (114.3), while the lowest fresh biomass of weeds was found in hand weeding (10.2 g m^{-2}) followed by glyphosate (13.23 g m^{-2}) and metribuzin (22.17 g m^{-2}). Similarly, dry biomass of weeds was the highest in weedy check plots (30.63 g m^{-2}) and the lowest dry biomass was found in hand weeding, glyphosate and metribuzin (2.42, 3.05 and 5.35 g m^{-2}, respectively). The largest tuber diameter was recorded in hand weeded plots (5.14 cm) followed by glyphosate treated plots (4.99 cm). The yield was the highest in hand weeding and glyphosate treatments (13750 and 13580 kg ha^{-1}, respectively). The herbicide treated plots were better in economic return as compared to the mulches and hand weeding practices; however among the herbicides the most remunerative treatments were metribuzin and glyphosate.

Key words: Herbicides, mulches, potato, *Solanum tuberosum,* weed.

INTRODUCTION

At the time of independence, potato was not an important crop in Pakistan. In 1947-48, only 2760 ha were under potato crop which produced about 27000 tons. The alternative return obtained from the potato crop is the major reason for its expanded production. Potatoes are produced from the sea level to 3000 m in altitude in varying agro-ecological environments in the country (Malik, 1995). A three years average from 2008-2011 showed that Khyber Pakhtunkhwa produced about 0.1329 million tons, from a total of 10600 ha area. While the

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total production in these three years in Pakistan was 2.12377 m tons, and the total area was 0.1109 m ha (Anonymous, 2011).

Potato is heavily infested with weeds, because of heedless application of fertilizers and wider row spacing which encourage the luxuriant growth of weeds. The crop on the other hand takes 10-15 days for emergence; in consequence weeds establish earlier and smother the crop. Hand weeding is though practiced but it is laborious, time consuming and expensive due to non-availability of labor at time when it is needed. The crop is thus partially weeded resulting in considerable loss of the crop. The conventional methods also injure and destroy the root system of potato resulting in poor yields. It is difficult to control weeds by cultural methods on very stony, steep ground and when the soil is too wet or too dry. Barring these aspects, chemical method of weed control appears to be promising over the physical method. Weed control with a chemical is a part of modern crop production technology and is one of the most outstanding discoveries of twentieth century (Shanmugavelue *et al.,* 2004).

The yield losses in potato crop caused by weed infestation vary from 10-80% (Malik, 1995). Learning to identify a weed is a first step towards its control in the crop associated. In Pakistan, potatoes are mainly infested with the *Amaranthus* spp., *Anagallis arvensis* L., *Avena fatua* L., *Chenopodium album* L., C*irsium arvense* (L.) Scop., *Convolvulus arvensis* L., *Cynodon dactylon* (L.) Pers., *Cyperus esculentus* L., *C. rotundus* L., *Portulaca oleracea* L., *Sonchus oleraceus* L., *Solanum nigrum* L., *S. sarrachides* and *Sorghum halepense* (L.) Pers (Malik, 1995).

Mulching has a smothering effect on weeds by restricting photosynthesis and thus inhibiting top growth. Mulching is very effective against annual weeds and some perennial weeds like *Cynodon dactylon* and *Sorghum halepense* etc. (Jayakumar and Jagannathan, 2007). One of the main advantages of mulches is the suppression of weed growth, thereby eliminating the need for inter cultivation of soil. Plastic mulches are found to offer satisfactory weed control in cotton and in vegetables. Application of higher rates of mulching has a depressive effect on the weed population (Jayakumar and Jagannathan, 2007). Keeping in view the importance of weeds in potato crop, the research was undertaken with the objectives to find out the most effective weed control method in potato, to evaluate the response of potatoes to different control methods viz. cultural and chemical and to figure out the most suitable herbicide for weed control in potato crop.

MATERIALS AND METHODS

The experiment was conducted at the Research Farm of the University of Agriculture Peshawar, Pakistan. The experiment was laid out in a randomized complete block design (RCBD) with four replications. Each treatment consisted of two ridges, eight meter long with row to row distance of 75 cm and plant to plant spacing of 25 cm. Both herbicides were applied as post-emergence to weeds, but pre-emergence to the crop, whereas the mulches were applied as pre-emergence to weeds as well as the crop (Table-1).

The previous year the land was used for forest nursery. Two plowings were done prior to the planting of potato and then the bed for potato was prepared. Planting was done in the advent of March, 2008. After plowing, nitrogen and phosphorus (Urea and DAP) fertilizers were applied at the rate of 120 and 100 kg ha^{-1}, respectively. All phosphorus and half of nitrogen fertilizers were applied at the time of soil preparation and incorporated into soil, and the other half of nitrogen fertilizer was applied before earthing-up and was mixed with soil. Earthing-up was done seven weeks after planting. Irrigation was done weekly during the growing season and harvesting in first week of July 2008.

Table-1. Treatments used in the experiment

S.No	Trade Name	Common Name	Time of application	Rate
1.	Weedy check	--	--	--
2.	Hand weeding	--	Post emergence	--
3.	White plastic	--	At emergence	--
4.	Black plastic	--	At emergence	--
5.	Wheat straw	--	At emergence	5 tons ha^{-1}
6.	Saw dust	--	At emergence	6 tons ha^{-1}
7.	Sencor 70WP	metribuzin	Post emergence to weeds	0.42 kg a.i ha^{-1}
8.	Round up 480 SL	glyphosate	Post emergence to weeds	0.48 kg a.i ha^{-1}

The data were record on weed density (m^{-2}), fresh biomass (g m^{-2}), dry biomass (g m^{-2}), no. of tubers $plant^{-1}$, tuber diameter, number of branches $plant^{-1}$ and tuber yield (kg ha^{-1}). The data were analyzed statistically, through MSTATC computer software and the means were separated by using LSD test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Weed density (m^{-2})

Statistical analysis of the data showed that weed density m^{-2} was significantly affected by different weed control methods. The most predominant weed species in the experiment were *Digitaria* sp.,

Cyperus rotundus, *Cynodon dactylon* and *Sorghum halepense.* Figure 1 showed that maximum weed density m^{-2} (155.3) was observed in weedy check which was statistically at par with black plastic (111.3). The minimum weed density was found in hand weeding (18.5) that was statistically at par with glyphosate (36.31) and metribuzin (49.17) treated plots. Rajalahti *et al.* (1999) controlled cereals' weeds by dead mulches and reported from zero to 95% control, but our observations from dead mulches (black plastic and white plastic) disagree with that. The main reason might be that our mulches were just applied within the row and not on the ridge. Jan *et al.* (2004) also reported that weed control with metribuzin was significant when applied as pre-emergence, but in our experiment metribuzin was applied as post-emergence, however our result from metribuzin are analogous with the aforesaid findings. However, contrary to our findings, Johnson *et al.* (2004) reported straw mulch at planting time suppressed weeds in their experiment.

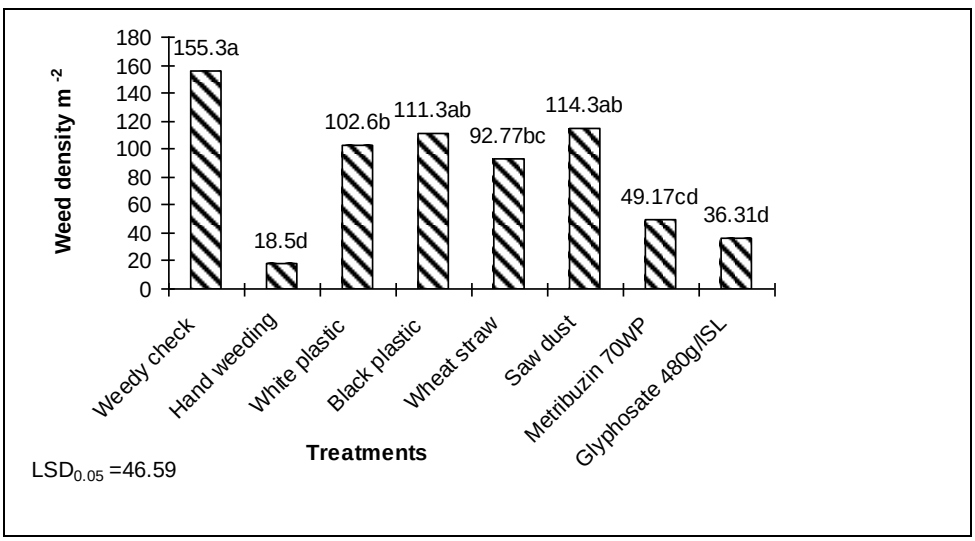


Figure 1. Effect of different weed control methods on weed density

Fresh weed biomass (g m^{-2})

Fig. 2 indicated maximum fresh biomass of weeds (130.9) observed in the weedy check plots, and minimum in hand weeding treatments (10.02) followed by glyphosate (13.23) and metribuzin (222.17) treated plots. However, all these three treatments were statistically at par. The saw dust (117.3), black plastic (92.63), white plastic (84.97) and wheat straw (66.63) were statistically comparable. Shah *et al.* (2003) reported that metribuzin treated plots regarding the

weed density and fresh biomass of weeds were effective in controlling weeds. This closely supports our findings, because in our trial the fresh biomass of weeds in hand weeding, glyphosate and metribuzin were the best treatments. Conley *et al.,* (2001) reported significant effect of herbicides on weed biomass.

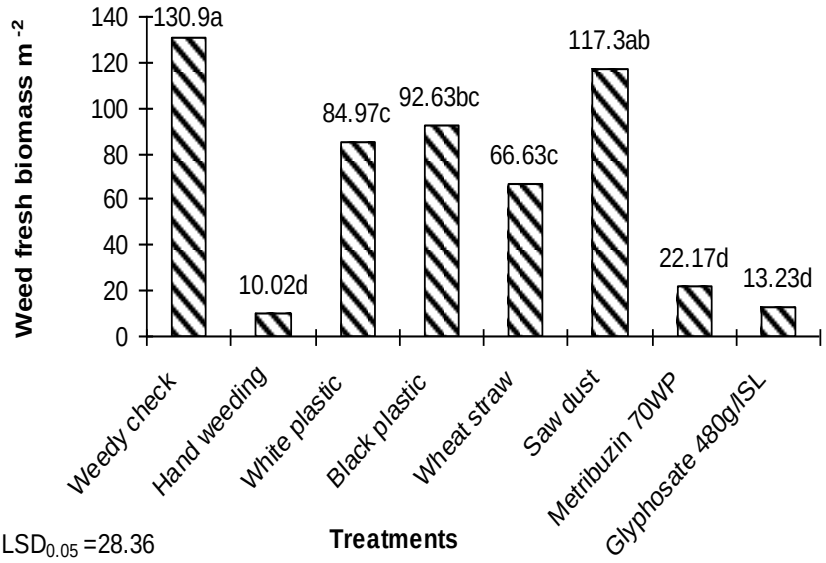
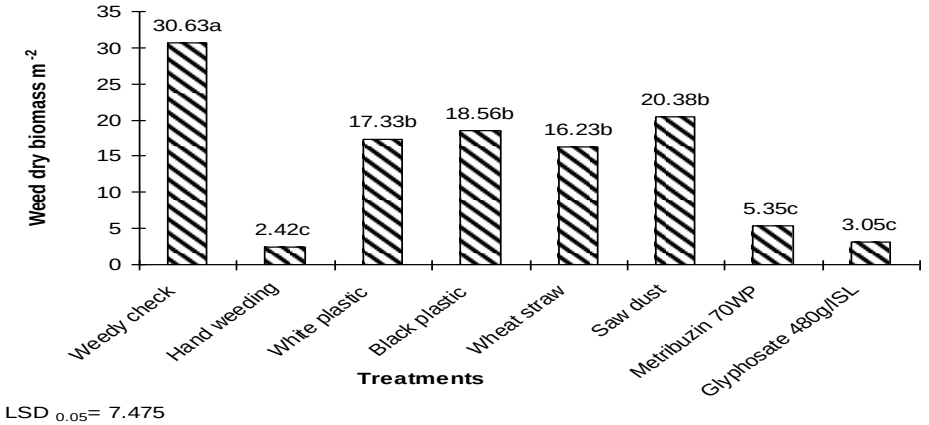


Figure 2. Effect of different weed control methods on fresh weed biomass (g m^{-2})

Dry weed biomass (g m^{-2})

The data in Fig. 3 show highest weed dry biomass (30.63g m^{-2}) recorded in weedy check ploys and lowest biomass (2.43 g m^{-2}) found in hand weeding treatment, that was statistically at par with glyphosate (3.05 g m^{-2}) and metribuzin (5.35 g m^{-2}). The rest of the treatments were however statistically at par. Our results are analogous with Hashim *et al.,* (2003) who reported highest weeds dry biomass in weedy check and lowest in hand weeding treatments. Boydston and Vaughn (2002) reported that chemical weed control significantly reduced the weed biomass.

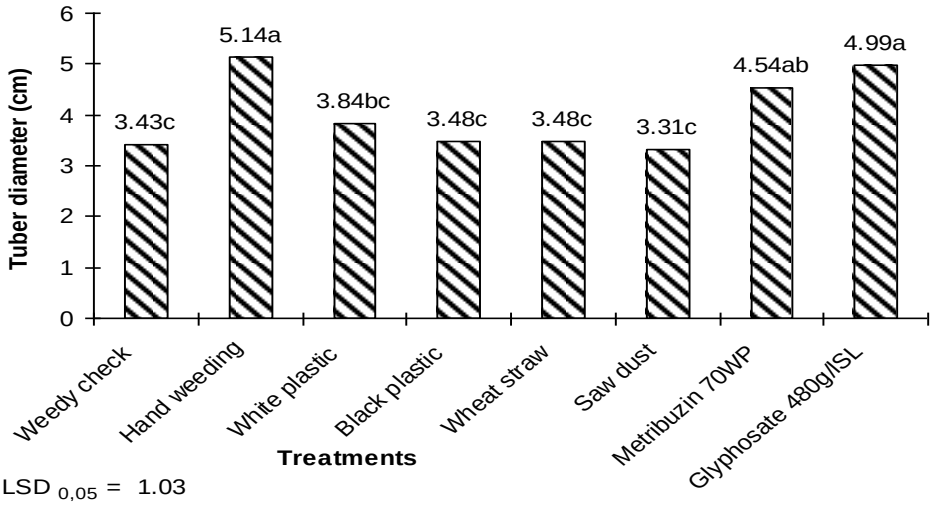


LSD $_{0.05}$= 7.475

Figure 3. Effect of different weed control methods on dry weed biomass (g m^{-2})

Tuber diameter (cm)

The highest tuber diameter of 5.14 and 4.99 cm were recorded in hand weeding and glyphosate treated plots, while the lowest (3.31 cm) sized tubers were recorded in saw dust treated plots, which were however statistically at par with weedy check (3.43), white plastic (3.84) and wheat straw (3.48) (Fig. 4). Chopra and Chopra (2007) reported that the size of onion in weedy check treatments was lesser than the treated plots, which is in agreement with our findings.

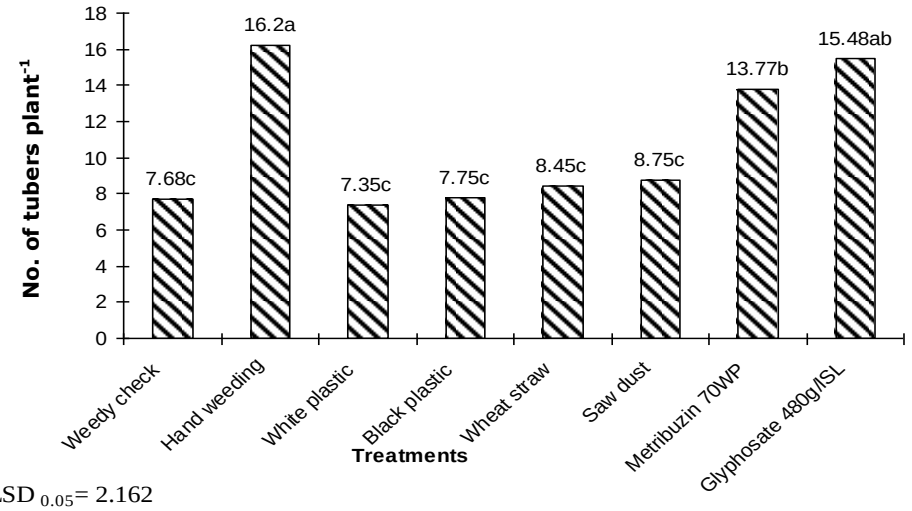


LSD $_{0,05}$ = 1.03

Figure 4. Effect of different weed control methods on tuber diameter

Number of tubers plant^{-1}

The mean data as shown in Fig. 5 exhibited maximum (16.17) number of tubers recorded in hand weeding plots, which was statistically at par with glyphosate (15.48) treated plots. The minimum (7.35) tubers per plant were counted in white plastic (7.35) which was statistically at par with weedy check (7.67), black plastic (7.75), wheat straw (8.45), and saw dust (8.75) treatments. The metribuzin (13.77) was intermediate in tuber production and statistically comparable with glyphosate (15.48). Hashim *et al.* (2003) reported that the number of tubers ha^{-1} did not differ statistically in their studies, whereas our findings exhibit, otherwise probably due to different set of treatments employed in the two studies.



LSD $_{0.05}$= 2.162

Figure 5. Effect of different weed control methods on number of tuber plant $^{-1}$

Number of branches plant^{-1}

Highest number of branches (2.35) plant^{-1} was found in glyphosate and the minimum (1.85) number of branches was recorded in the weedy check (Fig. 6). Ali and Khan (2008) reported significant effect of mulches on the number of branches plant^{-1} in okra crop, contrary to our findings. This could be due to the fact that the aforesaid study was undertaken on a different crop.

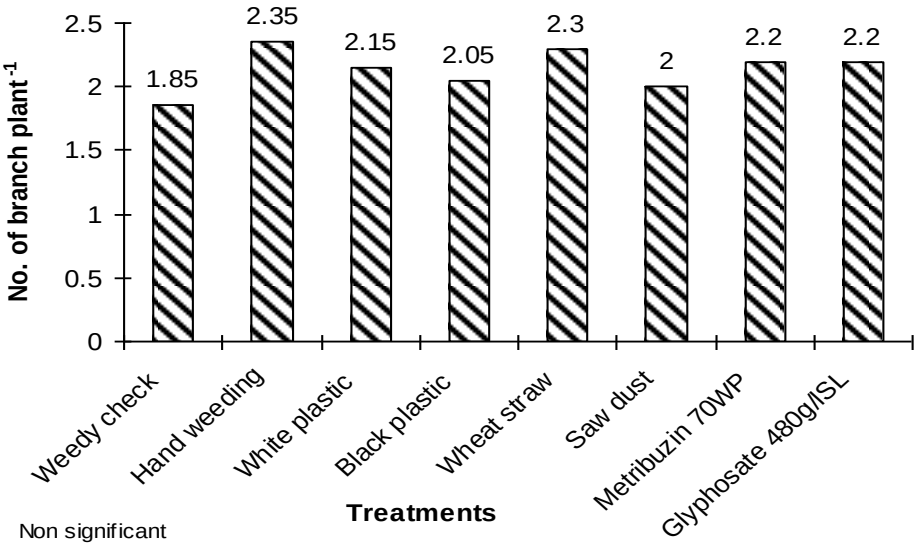


Figure 6. Effect of different weed control methods on number of branches plant^{-1}

Tuber yield (kg ha^{-1})

The comparison of the treatment means exhibited hand weeding and glyphosate treatments (13750, 13580 kg ha^{-1}, respectively) as the best treatments. Top scoring treatments viz. hand weeding and glyphosate were followed by metribuzin (11570 kg ha^{-1}). The minimum yield was found in weedy check (6004 kg ha^{-1}) which was however statistically at par with the white plastic (7251 kg ha^{-1}) and black plastic (7244 kg ha^{-1}) (Fig. 7). Baziramakenga and Gilles (1990) reported that the yield losses increased by the density and interference of grassy weeds. They further stated that the relationship between potato yield losses and grassy weed densities are described by a rectangular hyperbolic function. Jan *et al.,* (2004) also reported that the hand weeding treatment significantly increased the crop yield, closely supporting our findings.

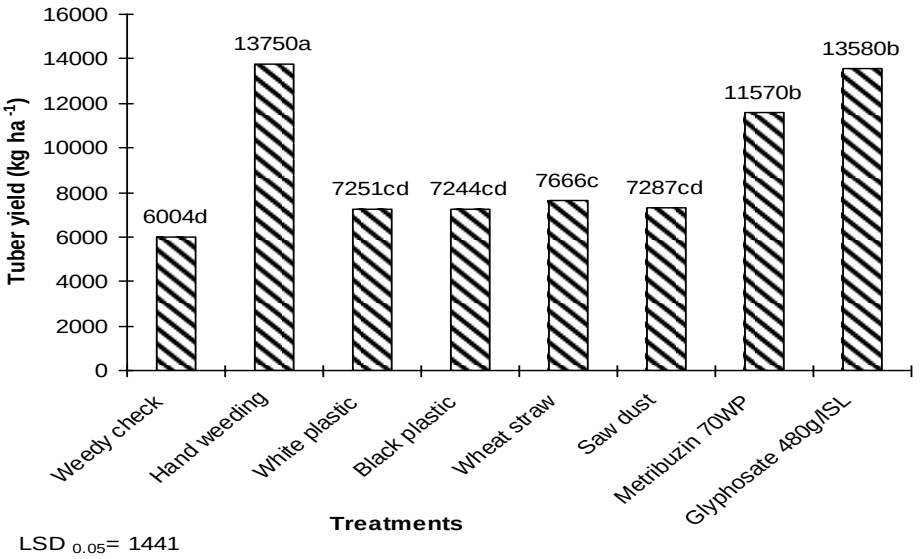


Figure 7. Effect of different weed control methods on tuber yield

CONCLUSION

This study investigated the mulches, herbicides and hand weeding potential for reduction in weed density, and high yield of potato crop. After analyzing the data it is concluded that the best treatments were herbicides treated plots and hand weeding. However, hand weeding treatments gave higher yields with higher costs, which by the existence of herbicides is not feasible. The natural mulches and the dead mulches were not effective in significantly suppressing weed germination, weed density and weed biomass, hence failed to increase the yield components and yield of potato crop. Thus, herbicides glyphosate @ 0.475 kg a.i. ha^{-1} and metribuzin @ 0.42 kg a.i. ha^{-1} are recommended to control weeds and increase potato yield.

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