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Comparison of Potato Yield, Quality and Weed Control Obtained With Different Plastic Mulch Colours

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ABSTRACT

Potato is a poor competitor against weeds. Field experiments were conducted to investigate the effect of five plastic mulch colours (black, white, blue and yellow) on potato yield and quality and associated weeds. The results indicated that the best weed control was achieved with black plastic mulch followed by hoeing, while the lowest weed control efficacy was obtained with white plastic mulch. Number and dry weight of *Portulace oleracea* seemed to be enhanced under the white plastic mulch condition. Un-controlling potato weeds caused a reduction in total yield and yield grade A by 43.5 % and 67.5 %, respectively. The rank order of different plastic mulches on controlling potato weeds and improving the tuber yield grade A per hectare over unweeded check was covering soil by black > blue > yellow > white plastic mulch. The economic return from using black plastic mulch was higher than that of hoeing (0.810 kg grad A ha^{-1}). Black plastic mulch, white plastic mulch and hoeing treatments recorded the highest values of N, Fe and Cu elements in the tubers, respectively. It could be concluded that black plastic mulch is potential substitutes for herbicides and hoeing, while yellow plastic mulch is ineffective for weed control in potatoes field.

Key words: Mulch, plastic colours, weeds, potato, quality

Introduction

Potatoes crops are poor competitive with weeds, so relatively weed-free condition are required for successful production. Weeds reduced potato tuber yield by 53.4% (Hidayat *et al*., 2013) to 86% (Monteiro et al., 2011). Controlling weeds led to 18-82% increment in tuber potato yield (Jaiswal and Lal, 1996). The standard methods of controlling weeds in potato crop have been limited to hoeing or herbicides (Eberlein *et al.,* 1997; Harker and O'donovan, 2013). However, the synthetic herbicides have residual effects in foods, soil, and water (Abouziena *et al*., 2008 and Serajchi *et al*., 2013). Moreover, the overuse of herbicides led to the rapid evolution of herbicide-resistant weeds (Powles and Yu, 2010).

Owing to acute shortage of hand labours and to avoidance herbicides uses, soil mulches can overcome these problems. Partly because of environment protection and partly because of ecological farming there is more and more attention on herbicide free weed control. One of the main questions of ecological vegetable production is weed management and possible answer is mulching, which besides its weed control role reduces evaporation too (Radics and Bognár, 2002).

Plastic mulches have various beneficial effects on crop production in arid regions, including crop earliness, crop cleanliness, prevent soil erosion, conservation of soil moisture and weed control as well as fertility and improving yield (Moreno & Moreno, 2008) and the control of weeds, pests and diseases (Kumar and Lal, 2012; Hidayat *et al*., 2013). Mahadeen (2014) found that using polyethylene plastic mulch significantly increased the okra and squash yields from 2.82 and 15.90 to 6.76 and 25.67 t ha^{-1}, respectively. Immirzi *et al.* (2009) reported that the main advantages of the plastic mulches are the decreased use of chemicals in weed control, reduced water consumption, faster crop development, improved plant health and better yield quality.

Plastic mulches caused 84-98% reduction in tomatoes weed biomass and black plastic mulch provided 90% and 84% or greater control of broad-leaf weeds and annual grass, respectively and caused a significant increase in tomatoes yield (Rajablariani *et al.,* 2012).

Different types and colours of plastic mulch have characteristic optical properties that change the levels of light radiation reaching the soil, causing increases or decreases in the soil temperature (Kasirajan and Ngouajio, 2012). Efficiency of plastic mulches varied according to the plastic colour i.e. white, black, blue, brown, green, red and yellow (Mahmood *et al.,* 2002; Grundy and Bond, 2007; Dvořák *et al*., 2012).

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Matheny *et al*. (1992) compared the effect of plant straw mulches painted with different colours of plastic mulch and concluded that plants receiving reflected light from the white, pale blue, and striped straw mulches produced > 15% more marketable tubers than the no-mulch control plants. Clear plastic mulches warm the soil and conserve soil moisture, while transmits light, resulting in conditions ideally suited for weed development.

Regarding to organic farming costs and benefits, Bayramoglu and Gundogmus (2008) reported that organic farming is a production system which has lower productivity per hectare, needs more labour and low energy inputs, follows crop rotation regularly and has a changing net income level relating with product selling prices. One of the mulch benefits beside maximization the plant productivity is water saving, where Mahajan *et al*. (2007) found that plastic mulch significant increase baby corn yield by 28.6% and resulted 30.6% of water saving, compared to unmulched soil treatment.

Therefore, the objectives of this study were to 1) test the efficacy of plastic mulches as a method of weed control for potatoes production; and 2) assess the effect of different colour applied mulches on potatoes yield, and crop quality grown in sandy soil.

Materials and Methods

Two field experiments were carried out at El-Salhia, Sharkia Governorate, Egypt, to study the effects of covering soil by different plastic colours on weeds and potato plants productivity. The experimental soil was sandy, having pH 7.9, E.C. 1.08 dSm^{-1}, organic matter 1.32%, total N 0.037%, total P 0.016% and total K 0.81%. A randomized complete design with three replicates was used. Plot size was $10.5m^2$ (3.5x3) including 5 rows 70cm width and 3 meter length.

Potato seed tubers (cv. Nicola) were planted at 25cm a part in 17^{th} January in both seasons. Before planting, the soil was ploughed, leveled and then furrowed at appropriate distances to suit the crop in the trial. Polyethylene plastic mulch 0.08 mm thick was laid out after soil preparation and before planting. The tuber seeds were sown by a hand chisel through the mulch at 25 cm intervals and the seedlings found their way through the film. The mulch remains on the soil till the end of season.

The treatments were (1) unweeded check; (2) hoeing three times at 21, 45 and 75 days after planting (DAP); (3) white plastic mulch; (4) black plastic mulch; (5) yellow plastic mulch; (6) blue plastic mulch; and (7) metribuzin herbicide (Sencor, 70% WP at 714 g ha^{-1}) applied 7 days after potato's planting (pre-emergence).

Chicken manure (containing total N 1.65%, P_2O_5 2.4% and K_2O 2.1%) was applied during soil preparation, at the rate of the chemical fertilizers [the recommendation of Agriculture Ministry in Egypt at the rate of 500 Kg N ha^{-1} as ammonium sulphate (20.6% N), 116 Kg P_2O_5 ha^{-1} as calcium superphosphate (15.5 % P_2O_5) and 240 Kg of K_2O ha^{-1} as potassium sulphate (48% K_2O)].

Before planting, the soil was ploughed, leveled and then furrowed at appropriate distances to suit the crop in the trial. Polyethylene plastic mulch 0.08 mm thick was laid out after soil preparation and before planting. The tuber seeds were sown by a hand chisel through the mulch at 25 cm intervals and the seedlings found their way through the film. The mulch remains on the soil till the end of season.

Data Recorded

Weeds were collected randomly from one square meter after 45 and 75 days from planting and number and dry weight of each weed species were recorded.

At harvest time, number and weight of tubers per plant, tuber weight and diameter, specific gravity by weighting in air and water and total soluble solids percentage (TSS% using hand Refractometer) were determined. Yield of tuber grade A (t ha^{-1}) based on tuber diameter (more than 3.5 cm) and total tuber yield (t ha^{-1}) were determined by harvesting the whole plot area.

Macro (N, P and K) and micro-elements (Zn, Mn, Fe and Cu) content in tubers were determined (AOAC, 1984).

Statistical analysis was exposed to the proper analysis of variance according to Snedecor and Cochran (1990). Least significant difference (LSD) at 5% level of significance was used to compare between means.

Results and Discussion

1. Weed Control

The dominant weeds in the experimental plots included common purslane (*Portulaca oleracea,* L.; POROL), bur-clover (*Medicago hispida,* Gaertn; MEDHI) and common lamb's-quarters (*Chenopdium album* L.*;* CHEAL) as broad leaved weeds and Ryegrass (*Lolium multiflorum,* Lam; LOLMU) as grassy weed in both seasons.

Number and dry weight of broad leaved, grassy and total weed population were significantly affected by weed control treatments (Tables 1 and 2). Adequate weed control efficiency was obtained by blue plastic mulch (94.2 and 73.5% at 45 and 75 DAP, respectively).

Table 1. Effect of weed control treatments on weeds number m^{-2} after 45 and 75 days from potato planting (Combined analysis of the two seasons)

Treatments	Weeds					
	POROL*	CHEAL	MEDHI	TBL	LOLMU	Total
	After 45 days					
Unweeded check	0.5	2.4	5.2	8.1	6.7	14.8
Hoeing	0.0	1.6	1.2	2.8	1.1	3.9
White plastic mulch	1.6	0.6	1.0	3.2	0.0	3.2
Black plastic mulch	0.0	0.0	0.0	0.0	0.4	0.4
Yellow plastic mulch	0.8	0.2	0.4	1.4	1.8	3.2
Blue plastic mulch	0.2	0.6	0.4	1.2	0.0	1.2
Metribuzin	0.0	0.6	1.2	1.8	3.0	4.8
LSD at 5% level	N.S	0.6	2.1	1.8	1.9	5.1
	After 75 days					
Unweeded check	8.4	6.0	12.6	27.0	5.6	32.6
Hoeing	1.2	1.8	1.2	4.2	1.0	5.2
White plastic mulch	2.4	3.0	3.6	9.0	4.2	13.2
Black plastic mulch	1.2	0.6	0.0	1.8	0.0	1.8
Yellow plastic mulch	5.8	1.2	5.4	12.4	5.4	17.8
Blue plastic mulch	4.2	0.0	2.4	6.6	2.6	9.2
Metribuzin	0.0	0.6	2.4	3.0	3.8	6.8
LSD at 5% level	3.9	2.8	5.5	6.6	2.7	8.1

**Abbreviations: POROL, Portulaca oleracea; CHEAL, Chenopodium album, MEDHI, Medicago hispida; TBL, Total broadleaved weeds and LOLMU, Lolium multiflorum.*

Soil mulching by white (75.2 and 47.2% efficacy control) and yellow plastic (75.1 and 50.5%) were not enough, in most case, to suppress weed growth (Fig. 1). In addition, number and dry weight of *Portulace oleracea* weed seemed to be enhanced under white plastic mulch (Tables 1 and 2). This effect was probably due to that the germination was enhancement by the warming effect of soil layers at which the seeds of tolerant weed species are present.

Mahmood *et al.* (2002) and Ashrafuzzaman *et al.* (2011) showed more dry weight of weeds when white plastic sheet was used in comparison to black plastic sheet. Rajablariani *et al.* (2012) reported that application of plastic mulch resulted in an 84-98% reduction in weed biomass. Johnson and Fennimore (2005) found that black plastic mulch reduced weed seed germination by 4% to 18.8% compared to the uncovered control.

Table 2: Impact of weed control treatments on the dry weight of weeds (g m^{-2}) after 45 and 75 days from potato planting (Combined analysis of the two seasons)

Treatments	Weeds					
	POROL*	CHEAL	MEDHI	TBL	LOLMU	Total
	After 45 days					
Unweeded check	4.8	9.8	13.8	28.4	6.2	34.6
Hoeing	0.0	0.4	2.4	2.8	0.7	3.5
White plastic mulch	1.2	0.8	2.7	4.7	3.8	8.5
Black plastic mulch	0.0	0.0	0.0	0.0	0.9	0.9
Yellow plastic mulch	3.4	0.6	3.7	7.7	0.9	8.6
Blue plastic mulch	0.4	0.4	0.7	1.5	0.5	2.0
Metribuzin	0.0	2.0	3.1	5.1	4.1	9.2
LSD at 5% level	1.8	1.9	5.7	7.9	2.9	7.1
	After 75 days					
Unweeded check	8.4	12.6	21.6	41.6	7.1	48.7
Hoeing	0.4	2.0	0.4	2.8	0.7	3.5
White plastic mulch	12.6	6.0	3.4	22.0	3.7	25.7
Black plastic mulch	2.0	1.4	0.0	3.4	0.0	3.4
Yellow plastic mulch	6.8	1.0	8.0	15.8	8.3	24.1
Blue plastic mulch	4.8	0.0	3.6	8.4	4.5	12.9
Metribuzin herbicide	0.0	2.0	5.2	7.2	3.9	11.1
LSD at 5% level	3.7	3.5	5.3	10.2	4.2	10.9

**Abbreviations: POROL, Portulaca oleracea; CHEAL, Chenopodium album; MEDHI, Medicago hispida; TBL, Total broadleaved weeds and LOLMU, Lolium multiflorum.*

Johnson and Fennimore (2005) and Dvořák *et al*. (2012) reported that white and green plastic mulches had little effect on weeds, whereas brown, black, or blue films prevented weeds emerging.

The variation of weed control efficiency among the different plastic colours may be attributed to their differences on soil temperature and the absorbance and transmittance of solar radiation (Ashrafuzzaman *et al.*, 2011). The role of plastic mulch on weeds may come through trapping radiant energy with clear mulch to create a greenhouse effect is possibly more efficient, while black plastic mulch controls weeds because weeds cannot grow in the absence of photosynthetically active light (Teasdale and Mohler, 2000).

Johnson and Fennimore (2005) reported that clear, blue and red mulch allowed the greatest amount of photosynthetically active radiation (PAR; 400 to 700 nm) to be transmitted through the mulch. they added that the mean separation reveals the following groups ranking from greatest to least PAR transmission: 1) clear, 2) blue, 3) red, 4) brown, green, yellow, 5) white/black, 6) black. They hypothesized that light transmittance and degree-hour accumulation are responsible for variation in weed biomass differences under the mulches.

Black plastic mulch provided similar levels of annual broadleaf weed control as hoeing treatment (Tables 1 and 2 and Fig. 1).

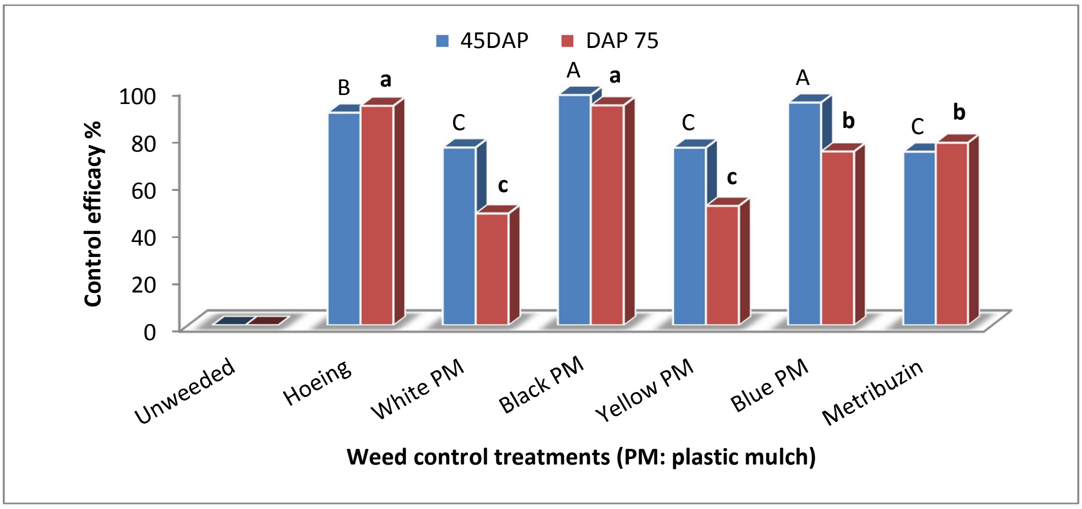

Fig. 1: Efficacy control % (Unweeded = 0 control) of some weed control treatments on the weed at 45 and 75 days after potato planting (DAP). (Combined analysis of the two seasons)

Gordon *et al.* (2010) and Rajablarijani *et al*. (2012) reported that black plastic mulch is the standard plastic mulch used in vegetable production. Black plastic mulch controls weeds because weeds cannot grow in the absence of photosynthetically active light (Teasdale and Mohler, 2000).

Application of metribuzin herbicide gave excellent control of broadleaved and total weeds. However, its effect on *L. multiflorum* was insignificant compared to unweeded check (Tables 1 and 2 and Fig. 1).

Similar findings were recorded on black plastic mulch (Uremis *et al.*, 2009; Rajablariani *et al*., 2012), on the other plastic colors (Ngouajio and Ernest, 2004; Ashrafuzzaman *et al*., 2011; Rajablariani *et al*., 2012), on hoeing (Shehata *et al.* 1990) and on metribuzin (Jan *et al.,* 2004; Hidayat et al., 2013). Application of metribuzin provided 99% reduction in total weed biomass each year (Eberlein *et al.*, 1997).

2. Yield and Yield Attributes

Weed interference with potato plants caused a significant reduction in tuber number plant^{-1} and tuber weight by 28.6% and 20.7%, respectively (Table 3) and consequently reduced the tuber yield per hectare by 43.5%, compared to hoeing treatment (Table 3 and Fig. 2). Mondani *et al.* (2011) found that weed competition reduced the total tuber yield by 54.8%, compared to hoeing treatment.

The reduction in tuber yield per plant due to weed interference may be attributed to that the weeds competition caused a reduction in the dry matter accumulation, leaf area index, crop growth rate, leaf area index duration, light absorption, light extinction coefficient and radiation use efficiency of potato (Mondani *et al*., 2011). Due to a long time from sowing to emergence of potato plants, and the long distance among the rows, weeds have enough area to growth using abundant water and nutrients which directly leads to rapid growth of weeds and decreasing the crop yield (Arnold *et al*., 1998).

Table 3: Impact of weed control treatments on potato yield (Combined analysis of the two seasons)

Treatments	Tubers number plant $^{-1}$	Tuber weight g^{-1}	Tuber yield g plant^{-1}	Tuber diameter cm^{-1}	Specific gravity of tuber	TSS %
Un-weeded check	7.0	50.3	351.1	4.4	1.06	8.0
Hoeing	9.8	63.4	621.3	4.6	1.07	8.2
White plastic mulch	8.3	65.4	542.8	4.6	1.07	8.0
Black plastic mulch	9.0	68.9	620.1	4.7	1.07	7.8
Yellow plastic mulch	9.0	55.8	502.2	4.4	1.06	8.2
Blue plastic mulch	8.2	66.2	542.8	4.7	1.06	7.8
Metribuzin	8.2	59.3	486.3	4.7	1.07	7.8
LSD at 5% level	0.9	17.5	72.2	N.S	N.S	N.S

Diameter, specific gravity and total soluble solids TSS (%) of tubers were not significantly influenced by weed competition; however some treatments increased the value of these criteria compared to unweeded check (Table 3). Similar finding was reported by Hidayat *et al.* (2013). Dvořák *et al.* (2012) found that the differences of vitamin C content in potatoes among variants with different types of mulching were not significant on average of both sites and years.

All weed control treatments increased to different extent the tuber yield per plant and per hectare over the unweeded chick. The greatest tuber yield was obtained with black plastic mulch, which significantly surpassed all other treatments, except hoeing treatment (Table 3 and Fig. 2). Similar finding on tomato was reported by Bakht and Khan (2014).

Black plastic mulch increased the tuber yield per hectare by 14.5, 23.5, 14.3, 27.5 and 76.7%, than white, yellow, blue, and metribuzin and unweeded treatment, respectively (Fig. 2). Similar effects were reported with Jaiswal (1995). Mulch provides many benefits to crop production through soil and water conservation, enhanced soil biological activity and improved chemical and physical properties of the soil (Kumar and Lal, 2012; Mahadeen, 2014) and improved microclimate both beneath and above the soil surface (Mondani *et al*., 2013), effectively controlled the weed growth and increased soil temperature resulting in faster emergence, early canopy development and higher tuber yield (Jaiswal, 1995; Bakht and Khan, 2014).

The superiority of black plastic mulch may be the result of the high weed control efficiency (Tables 1, 2 and Fig. 1) and provided soil condition more favorable to efficient N utilization than transparent plastic mulch (Jan *et al.,* 2004). Plastic mulches directly impact the microclimate around the plant by modifying the radiation budget (absorbitivity vs. reflectivity) of the surface and decreasing the soil water loss.

The results of yield grade A indicated that this character take the same direction of total tuber yield, where weed competition reduced the yield of grade A by 68.1%, compared to hoeing treatment (Fig. 2). It was noticed from results in Table (3) that colour of plastic mulch had significant effect on yield grade A, where covering soil by black, white, yellow or blue plastic yielded more tuber yield grade A per hectare than unweeded check by 18.76, 13.92, 9.26 and 14.31 t ha^{-1}, respectively. Among the weeded treatments, black polyethylene mulch followed by hoeing treatments gave the highest yield of tuber grad A (Fig. 2). Similar finding was reported on tomato crop (Johnson and Fennimore, 2005) and on potato (Jan *et al.,* 2004; Hidayat *et al*., 2013). These results may be due to that hoeing and mulching treatments reduces tuber exposure to sun light, which reduces tubers greening and surface hoeing may a cerate and improve structure of some soils, especially those high in silt and very fine sand (Eberlein *et al.*, 1997) and mulching reduced insect pest damage (Purser, 1993).

Rajablarijani *et al.* (2004) reported that marketable yield increased by 50% in black, followed by blue (40%), red (26 %) and clear plastic mulch (24%). They added that the increase in yield of mulched plot was probably associated with the conservation of moisture and improved microclimate both beneath and above the soil surface and great weed control, especially in black plastic mulch. Similar finding was reported by Mondani *et al*. (2011). The effect of mulches on potato yield might be resulted from not only better weed control but also increasing soil temperature, especially under transparent one (Mondani *et al*., 2011). Some colours like yellow attract certain insects like green pea aphids and cucumber beetles (Lamont, 1999). In fact, transparent and black mulches increase soil temperatures, but black plastic provides effective weed control (Teasdale and Mohler, 2000).

The colour of mulch largely determines its energy-radiating behavior and its influence on the microclimate around a vegetable plant. Hidayat *et al*. (2013) reported that plastic colour affects the surface temperature of the mulch and the underlying soil temperature; however, insignificant difference between white and black plastic mulches on tuber yield was recorded. Mulching soil by black plastic gave similar tuber yield to that of hoeing treatment. This effect could be explained by the effect on weed growth, since weeds were reduced to the same level in both treatments.

Data in Fig. (2) also indicated that application of metribuzin significant increase the tuber yield per plant, and per hectare. Similar finding was reported (Channappagoudar *et al.*, 2007). It can be concluded that the use of herbicides also offers a good alternative in case of skilled labour scarcity for potato production under conventional sowing method. It's worthy to mention that herbicides residual was found in potatoes tubers (John *et al*., 2013), therefore using mulch treatments for weed control in potatoes field was safe.

Black plastic mulch treatment increased tuber yield grade A by 3.1% (810 kg ha^{-1}) over hoeing treatment (Fig. 2). This effect could not be explained by the effect on weed growth, since weeds were reduced to the same level in both treatments. It is possible that black polyethylene increased the root volume (Ashrafuzzaman *et al*., 2011), improved the availability and uptake of nutrients and decreased the water depletion from the soil (Smeda and Weston, 1995; Taparauskienė and Miseckaitė, 2014). Mahadeen (2014) reported that the black plastic mulch reduced soil water evaporation and improve soil water retention. He added that using polyethylene plastic mulch produced earlier seedling emergence, more vigorous plant, earlier and higher yield as compared to non-mulched treatment. Black plastic mulch significantly increased the tuber yield grade A than that of white, yellow and blue plastic mulch by 21.5, 53.1 and 19.4%, respectively (Fig. 2).

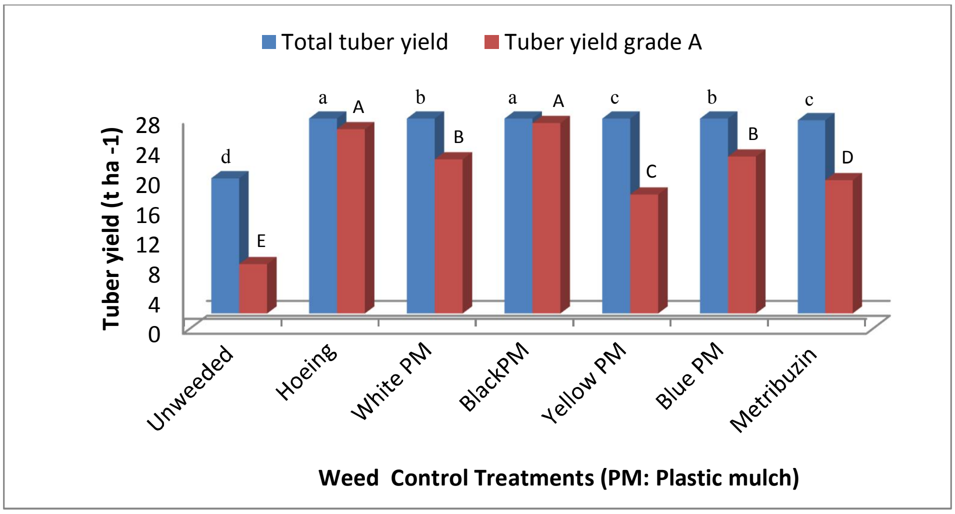

Fig. 2: Effect of Weed Control Treatments on Total Tuber Yield and Tuber Yield Grade A (t ha^{-1}) (Combined Analysis of the Two Seasons)

Yellow plastic mulch treatment produced the lowest tuber diameter and weight and consequently gave the lowest tuber yield grade A, compared to other weeded treatments (Fig. 2). However this treatment gave higher tuber yield than unweeded check by 43% (Table 3 and Fig. 2). This result may be attributed to the lowest weed control efficacy (Tables 1, 2 and Fig. 1). Geyer *et al.* (2006) reported that clear and yellow plastics deteriorated rapidly and blue, clear, and yellow plastic mulches deteriorated during the first growing season, thus they did not control the weeds as well as the others.

Concerning the costs of mulches treatments comparing to hoeing treatment, it could be stated that the costs of mulching are higher than that of hoeing operations (data not shown). But there are some important things must mentioned: 1) the economic return from using mulching was more higher than that of hoeing (0.810 kg ha^{-1} = about 0.810 $; increase in yield grad A, with black plastic mulch); 2) the unavailable and scarcity of workers at adjust time especially in the new reclaimed area which out of the rural areas and the available option for weed control is the herbicides which are not allowed in organic farming; and 3) at a high density of weeds intensive weeding will required (Bangarwa *et al*., 2010), which can further increase labor cost. This finding was coincidence with Khan *et al*. (2009) who reported that overall net income was greater in hand weeding treatment; the net benefit was the highest under hand weeding, closely followed by Sencor. Ghorbani-Faal *et al.* (2013) reported that in hand weeding treatment the gross income is high but its net income was lower than those for all other management treatments. Also, McMillen (2013) reported that plastic mulches have a higher initial cost. They added savings in water and improvement in crop performance coupled with the soil building properties would likely justify the cost. It could be concluded that the benefits from mulched could easily lead to considerable savings in water and improved plant growth could reduce overall costs of production (McMillen, 2013).

3. Nutrients Content in Tuber

There are very few data in the literature concerning the influence of plant protection agents, including herbicides, on mineral contents in potato tubers (Gugala *et al*., 2012). Weed competition had no significant effect on P, K, Zn and Mn contents of tuber (Table 4). Similar finding was reported by Shehata *et al.* (1990).

Data in Table (4) also show that hoeing treatment had the highest Cu content in tuber. Controlling weeds by black plastic mulch exhibited the highest significant value of nitrogen content in tubers.

Mulches prevented nitrates being washed out of the soil and reduce nitrogen losses by immobilization of post-harvest nitrate (Döring *et al*., 2005; Ogban *et al*., 2008). Gugala *et al*. (2012) reported that the elements content in potatoes depended significantly on weed control methods during the growing season, and the highest magnesium content was recorded in the tubers of potato sprayed with metribuzin.

Table 4: Impact of Weed Control Treatments on Macro and Micro-Nutrients of Potato Tubers after Harvest (Combined analysis of the two seasons)

Treatments	Macro-elements (%)			Micro-elements (ppm)			
	N	P	K	Zn	Mn	Fe	Cu
Unweeded check	1.14	0.19	1.9	9.0	6.4	60.2	1.8
Hoeing	1.17	0.25	1.9	9.3	6.4	54.5	3.8
White plastic mulch	1.04	0.17	1.8	10.5	5.9	96.6	1.2
Black plastic mulch	1.63	0.17	1.9	11.5	6.8	71.2	1.5
Yellow plastic mulch	1.11	0.19	1.9	10.7	7.1	96.3	1.8
Blue plastic mulch	1.32	0.17	1.7	10.4	5.9	80.1	1.5
Metribuzin	1.21	0.20	1.9	9.7	6.7	73.8	1.8
LSD at 5%	0.28	N.S	N.S	N.S	N.S	26.5	1.3

Conclusion

Weed interference caused a significant reduction in tuber number plant^{-1} and tuber weight and consequently reduced the tuber yield by43.5%, while diameter, specific gravity and total soluble solids (%) of tubers were not significantly affected by weed competition. In organic farming potatoes, quality (free from synthetic chemical agriculture) is often more important than yield. Our results show that most weed species were controlled by the mulching materials except that *Lolium multiflorum* was controlled only by white plastic mulch. Best weed control and lowest weed biomass were achieved by black plastic mulch (BPM) followed by hoeing treatment. Poor weed control efficiency was obtained by yellow and white plastic mulches (47.2% and 50.5%), while adequate weed control was obtained by blue plastic mulch (73.5%). Number and dry weight of *Portulace oleracea* seemed to be increased under white plastic mulch. The rank order of different plastic mulches on controlling potato weeds and improving the tuber yield grade A per hectare over unweeded check was covering soil by black > blue > yellow > white plastic mulch.

Potato yield grade A was highest for black PM, blue PM, yellow PM, white PM, and metribuzin and was clearly related to weed control. The economic return from using black plastic mulch was higher than that of hoeing. Therefore it can be concluded that black plastic mulch is potential substitutes for herbicides and hoeing, while yellow plastic mulch is ineffective for weed control in potatoes field.

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