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EFFECT OF SOME HERBICIDES AND MULCHING TREATMENTS AS NATURAL ALTERNATIVES USED FOR WEED CONTROL AND PEA (*Pisum sativum* L.) PRODUCTIVITY WITH MONITORING HERBICIDE RESIDUES.

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ABSTRACT

A two-year field experiment was carried out at Sids Horticulture Research Station during 2015/2016 and 2016/2017 winter seasons to study the effect of thirteen weed control treatments. The treatments were Amex 2.5 l/fed., Amex1.875 l/fed. followed by one hand hoeing at 40 days after sowing; Ultra afalon 1L/fed., Ultra afalon 0.750 l/fed. followed by one hand hoeing at 40 days after sowing; Stomp extra 1.7 l/fed., Stomp extra 1.275 l/fed. followed by one hand hoeing at 40 days after sowing, Gesagard 1.5 l/fed., Gesagard 1.125 l/fed. followed by one hand hoeing at 40 days after sowing; mulching by black, green and transparent polyethylene sheets, hand hoeing twice at 20 and 40 days after sowing as compared with unweeded check in complete randomized blocks design with three replicates on weeds, pea yield and its components. Herbicide residues were also monitored by HPLC chromatography in seed green pea. Results show that the best treatments for controlling total annual broad leaf and grassy weeds and the highest yield correlated negatively with weed biomass as g/m^2 and positively with yield components of pea with mulching by black and green polyethylene sheets and exceeded applied soil acting herbicides of Amex, Ultra afalon, Stomp extra and Gessagard and were almost equal to the above mentioned reduced rates of these herbicides followed by hand hoeing. For herbicide residues detection in green pea seeds was found to be below the maximum residue limit with single herbicide or their reduced rates combined with one hand hoeing. Both Ultra afalon or Gessagard treatments residues were lower than Stomp extra or Amex herbicides. Stomp extra 1.275 l/fed. followed by one hand hoeing at 40 days after sowing and mulching by black polyethylene were the best treatments for weed control and pod green yield in both season. The highest fresh pod yield (ton/fed.) or seed yield (kg/fed.) and correlated negatively with the different studied weed categories. Gessagard followed by one hoeing or Stomp extra followed by one hoeing and mulching by black polyethylene treatments were economically feasible than other weed control treatments. Mulching by black and green polyethylene sheets can be recommended as a good and clean alternative for weed control by herbicides in pea crop and can be used in organic farming systems.

Key words*: weed control, Amex, Ultra afalon, Stomp extra, Gesagard, hand hoeing, polyethylene mulching, herbicides residues, pea.*

1. INTRODUCTION

Pea is one of the important grain legumes grown in various parts of the world. Weeds cause 37.3 to 64.4 percent reduction in pea yield (Banga *et al*., 1998). Integrated weed management (IWM) is considered as an integral component of sustainable agriculture from the agronomic, economic and environmental perspectives. Cultivation and hand hoeing are the traditional weed control measures. In Egypt, hand hoeing is the method which has been employed to destroy weeds from all fields and resulted in good control of weeds but hand hoeing was the most expensive weed control method employed (Ibrahim, 1981). Khan *et al*. (2003) stated that pod length (9.6 cm), number of seeds pod (6.14) and pod yield (4673 kg\ ha.) were maximum in hand weeding followed by post emergence in application of metribuzin treated plots. Tamana *et al*. (2009) revealed that all the parameters except plant height were significantly affected by different weed control

treatments. Hand weeding produced better results as compared to the other treatments from the viewpoint of weed control. Maximum number of pods/plant, number of seed pod and pod yield were recorded in hand weeding and mulches polyethylene black treatments, respectively. Sajid *et al.* (2012) found that Stomp 330 and 50% EC (pendimethalin) were equally superior in terms of higher pods yield and yield components by reducing weeds density and weed biomass. Fakkar and El-Dakkak (2015) found that weed control treatments significantly decreased the numbers and dry weight of grassy, broad-leaved and total weeds (g/m^2) in both seasons. Application of hand hoeing at 20, 45 days after sowing, Gesagard at 1.0 L/fed. +Select super and Basagran at 500 cm^3/fed. + Select super at 500 cm^3/fed. gave the highest reduction of the dry weight of grassy, board-leaved and total weeds (g/m^2) in both seasons. Hand hoeing at 20, 45 days after sowing, Gesagard + Select super and Basagran + Select super significantly increased the plant height, number of branches/plants, pod length, pod width, 100-green seed weight (g), green pod yield (ton/fed.) and dry seed yield (kg/fed.). Gough (2001) reported that colored mulches affected crop yield in multiple ways, such as affecting soil temperature. Ngouajio and Ernest (2004) found that these colors allow mulches to reflect different radiation patterns into the plant canopy and affect photosynthesis and/or plant morphogenesis, and increase early and total yields. Moursy *et al.*(2015) found that obtained all the advantage from soil mulching is a direct result of controlling the microclimate around the plants. Soil mulch is governing microclimate depending on the thermal properties for the particular material such as reflectivity and absorption or transmittance of the incoming solar radiation. Awal *et al.* (2016) reported that weed growth was suppressed by black polyethylene mulch, whereas it was promoted under transparent film followed by the no mulched soil. The highest seed yield was obtained from the crops grown with black or transparent polyethylene mulching. Black or transparent polyethylene sheet can be used as an effective mulching material for better yield of pea crop. Waseem *et al.* (2018) found that the maximum pod yield was recorded from hand weeded plots, followed by black plastic. Stomp and clear plastic were statistically at par with respect to pod yields. It was concluded from the results that the highest yield of pea and effective weed control were achieved by three hand weeding followed by black plastic mulch. Gad EL-Moula *et al.* (2018) reported that black mulch was more suitable to increase soil temperature. Vegetative growth characteristics of tomato plants were enhanced by using the green mulch. The green (for tomato) soil mulches gave the highest yield. The favorable effect of polyethylene soil mulches on plant growth and yield due to increasing N, P and K percentage as well as total soluble solids and ascorbic acid content. Kulshrestha *et al.*(2000) found that Pendimethalin is rapidly lost by photodecomposition, microbial degradation and volatilization. Sondhia (2008) and (2010) found that pendimethalin is classified as a non-leaching compound and has been used as herbicide for controlling weeds in crop fields that are used in daily food plant. Lin *et al.* (2007) found that pendimethalin as a pre-emergence herbicide is effective for the control of annual weeds in leguminous and other pea crops. Kol *et al.* (2002) reported that field dissipation studies revealed that pendimethalin is persistent, and its half- life is 98 days at 30ºC.

The main goals of this work were to study the effects of different herbicides and mulching methods controlling weeds in pea and monitoring herbicide residues in seed green pea. Economic feasibility and correlation studies were done between various traits of pea and their associated weeds.

2. MATERIALS AND METHODS

Two-year field experiment was carried out at Sids Horticultural Research Station, Beni-Suef Governorate, Horticultural Research Institute, Agricultural Research Center, Egypt, in clay soil (Table 1) during two successive winter seasons

Table (1): Mechanical and chemical analysis of the experimental soil.

Mechanical analysis				Chemical analysis			Available nutrients					
Sand %	Silt %	Clay %	Texture	OM	PH	E.C mmhos /cm	N%	P (ppm)	K (ppm)	Fe (ppm)	Mn (ppm)	Zn (ppm)
19.8	30.8	49.4	Clay loam	1.55	7.72	1.1	0.1	29.2	370.1	33.0	19.0	5.7

2015/2016 and 2016/2017. The aim was to study the effect of thirteen weed control treatments on weeds and yield component of pea (*Pisum sativum* L.) cv. Entesar 2 as medium maturity variety in a randomized complete block design with three replicates.

The treatments were as follow:

1. Amex 48% EC (butralin) applied at rate 2.5 l/fed. on soil surface as pre sowing.
2. Amex 48% EC(butralin) at rate 1.875 l/fed. as pre- sowing, followed by hand hoeing after 40 days from sowing.
3. Ultra afalon 45% SC (linuron) applied at rate 1.0 l/fed. as on soil surface as sowing.
4. Ultra afalon 45 % SC (linuron) at rate 0.750 l/fed. as pre- sowing then followed by hand hoeing after 40 days from sowing.
5. Stomp extra 45.5% CS (pendimethalin) applied at rate 1.7 l/fed. on soil surface as sowing.
6. Stomp extra 45.5 % CS (pendimethalin) at rate 1.275 L/fed. as pre- sowing, followed by hand hoeing after 40 days from sowing.
7. Gesagard 50% SL (Prometryn) applied at rate 1.5 l/fed. on soil surface as sowing.
8. Gesagard 50% SC (Prometryn) at rate 1.125 l/fed. as pre- sowing, followed by hand hoeing after 40 days from sowing.
9. Black polyethylene mulch 0.150 mm thick.
10. Green polyethylene mulch 0.150 mm thick.
11. Transparent polyethylene mulch 0.150 mm thick.
12. Hand hoeing twice at 21 and 40 days after sowing.
13. Unweeded check (control).

The used herbicides characteristic are presented in Table (2).

Herbicides were applied by CP3 knapsack sprayer with 200 L\fed. on soil surface while plastic sheets covered soil surface and holes by using mineral tubes with sharped edge with 10 cm distance between holes. After ten days of soil irrigation all treatments were sown by two seeds per hill from the medium maturity Entesar 2 cultivar seeds. Seeds were planted in six rows (three rows used for fresh pods yield and three rows used dry seeds yield). The experimental unit area was 16.8 m^2. Each row was 4 m long and 0.7 m wide, Planting dates were 17^{th} October in both seasons. The other agricultural practices were done as recommends.

2.1. Data recorded

2.1.1. Weeds characters: weed assessment was carried at 60 days from pea sowing where weeds were hand pulled from one square meter which were chosen at random from each plot and weeds were identified to its species according to Tackholm (1974) and

Table (2): Trade names, common names, formulations % *a.i.*, chemical names and mode of action of the four herbicides used in the current study.

Trade name	Common name	Formulation and % *a.i.*	Chemical name	Mode of action
Amex	**Butralin**	**48%EC**	**(4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6 dinitrobenzenamine)**	**- Inhibits microtubule formation and disrupting cell division.**
Ultra afalon	**Linuron**	**50% WP**	**(3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea)**	**-Photosynthetic electron transport inhibitor at the photosystem II receptor site.** **-Selective systemic herbicide, absorbed principally by the roots but also by the foliage, with translocation primarily acropetally in the xylem.**
Stomp extra	**Pendimethalin**	**45.5% CS**	**(N-(1-ethylpropyl)–3,4dimethyl2,6dinitro benzenamin)**	**-Inhibits cell division and cell elongation. It is listed in the K1-group according to the HRAC classification.**
Gesagard	**Prometryn**	**50% SC**	**(N2,N4-di-isopropyl-6-methylthio-1,3,5-triazine-2,4-diamine)**	**- Photosynthetic electron transport inhibitor at the photosystem II receptor site.** **- Selective systemic herbicide, absorbed by the leaves and roots, with translocation acropetally through the xylem from the roots and foliage, and accumulation in the apical meristems.**

their fresh weight as gram per square were divided into the following groups:

1- Annual grassy weeds (g/m^2).
2- Annual broad-leaved weeds (g/m^2).
3- Total of annual weeds (g/m^2).

2.1.2.Vegetative growth traits: plant height(cm) and number of branches/plant, where ten plants were taken at random from each plot after 70 days after sowing.

2.1.3. Pea yield and yield components: twenty green pods at random from each plot from the second harvest were taken at marketable green-maturity stage in the second harvest (80 days after sowing): pod length (cm), pod width (cm), number of seeds/pods, fresh pod weight (g), fresh seed weight/pod (g), Shell-out % = seed weight per pod/pod weight ×100, fresh pod yield (ton/fed.), while dry seeds yield were estimated (kg/fed.) and recorded as dry harvest.

2.1.4. Protein content%: dry seed samples were taken randomly from each experimental plot and oven dried at 70°C until constant weights and then were ground and digested to determine total nitrogen percentage (N %) by micro-Kjeldahl apparatus of Parnase and Wangar as described by Pregl (1945). Protein percentage was measured by multiplying the total nitrogen (N) values by 6.25 according by Pregl (1945). .

2.2. Herbicide residues determination, herbicide residues for Amex (butralin), Stomp extra (pendimethalin), Ultra afalon (linuron) and Gesagard (prometryn) in green seeds of the second gathering of pea at 80 days after sowing were determined in Central Laboratory for Pesticides, Agriculture Research Center, Dokki, Giza, Egypt.

2.2.1. HPLC Analysis: The type of chromatographic HPLC system model (Agilent Technologies 1260 Infinity) with Quaternary pump, UV-detector was employed. The chromatographic C18 stainless steel column (25 cm length, 4.6 mm inner diameter, and 4.0 µm particles).

2.2.2. Extraction and cleanup of herbicides Beside the levels of pendimethalin, butralin, prometryn and linuron herbicides in green pea were determined according to the method of EL-Beit *et al.* (1978) with some modifications. Fifty grams of each sample were homogenized in a blender containing 100 ml of methylene chloride , then the solvent was filtered through Whatman filter paper No.1 and dried over anhydrous sodium sulphate. The filtrate was evaporated till dryness, and the residues were quantitively transferred into small vials (5 ml) acetone which evaporated at room temperature. The vials with residues were kept at -10˚C for cleanup. The resulting extracts of green pea were cleared by C18 cartridge column chromatography. The herbicides extracts were evaporated at 30˚C to dryness residues which dissolved in 1ml acetonitrile and then determined in fortified untreated samples. Following the techniques previously mentioned, the rate recovery of pendimethalin, butralin, prometryn and linuron were 98.99, 99.12,88.2 and 89.56% for each herbicide respectively.

2.3. Economic feasibility study: cost of green pods yield of pea per fed. was estimated and compared among the 13 treatments. The mean price for pods yield was 4000 Egyptian pounds /ton. Price as black polyethylene mulch for kilogram (kg) (4 x10 m^2, respectively) = 20 L.E, green polyethylene mulch for kilogram (Kg) = 15 L.E, transparent polyethylene mulch for kilogram = 15 L.E, Amex (1 liter) = 250 L.E, Ultra afalon(1 liter) = 260 L.E, Stomp extra (1 liter) = 230 L.E , Gessagard (1 liter) = 150 L.E and two hoeing = 1200 L.E, respectively. Economic analyses were performed to estimate returns and profitability using the following formula according to Heady and Dillon (1961) and Dunan *et al.* (1995) with some modification:

Gross income (GI) = total yield x price

Total cost of increased= increased yield/fed./all of yield x cost of all yield

Net income (NI) = gross income – total costs

NI of increased= gross income of increased – cost of increased yield

Profitability (P) ={net income (NI) /total costs(TC)} x 100

Profitability of increased = (net of increased/TC of increased) x100

Benefit/ costs ratio (B/C) = gross income (GI) / total costs (TC)

The collected data were statistically analyzed according to the method described Snedecor and Cochran (1981). Means were compared using Duncan's multiple range test as published by Duncan (1955). All statistical analyses were performed using analysis of variance technique by means of MSTATC computer software package (Freed *et al.*, 1991). The simple

correlation coefficients were calculated following Singh and Chaudhary (1985).

3. RESULTS AND DISCUSSION

Effect of weed control treatments

3.1. Weeds characters

Weed survey in experimental fields showed that annual predominat weed species in both seasons were cheese weed mallow (*Malva parviflora* L.), Sea beet wild beet (*Beta vulgaris* L.); dentated dock (*Rumex dentatus* L.), (water cress) *Coronopus squamatus* L.), (shepherd's purse) *Capsella bursa-pastoris* L, (bishop's weed) *Ammi majus* L.), sun spurge (*Euphorbia helioscopia* L.) and (sow- thistle*Sonchus oleraceus* L.; as annual broad-leaved weeds and lesser canary grass (*Phalaris minor* L.), wild oats (*Avena sterilis* L.) and jungle rice (*Echinochloa colonum* L.) as annual grassy weeds which were the most important weeds of pea crop. The level of weed infestation in both seasons show that the rate of infestation in unweeded check reached to 12.7 and 13.5 ton fresh weight per fed., where the mixture of weed species was represented by 22.7 and 77.3% broad leaf and grassy weeds, respectively. This means that the experimental field had heavy weed infestation which helped in determing weed control efficiently. Jukka *et al*. (2005) showed that herbicides decreased the number of weed species per field from *Chenopodium album, Stellaria media and Viola arvensis* and *Elymus repens* species. Weed control decreased dry weight of weeds by (38.7% and 37.6%) in both seasons, respectively. Salonen *et al*. (2005) noted that the most frequent from 76 weed species in both cropping practices were *Chenopodium album, Stellaria media* and *Viala arvensis*. *Elymus repens* was the most frequent grass species under conventional cropping.

Data in Table (3) show that the effects of all weed control treatments can be arranged in descended order decreased significantly on their effects on the fresh weight of broad-leaved, grasses and total weeds as compared with unweeded check in both seasons. Stomp extra (1.275 l./fed.) followed by one hoeing treatment which gave the highest controlling percentage of broad-leaved, grasses and total weeds which reduced fresh weight by 99.8,99.8 and 99.8% in first season and 99.3, 99.2 and 99.3% in the second season followed by black polyethylene soil mulch, Amex (1.875 l./fed.) followed by one hoeing, Gesagard (1.125 l./fed.) followed by one hoeing, green polyethylene mulch and hand hoeing (twice) treatments in both seasons than other treatments. For individual herbicides Stomp extra (1.7 l./fed.) was the best of broad-leaved, grasses and total weeds in both seasons. For herbicide followed by one hoeing, the treatments Stomp extra (1.275 l./fed.) followed by one hoeing, Gesagard(1.125 l./fed.) followed by one hoeing and Amex (1.875 l./fed.) followed by one hoeing were the best treatments of broad-leaved, grasses and total weeds in both seasons. For soil mulching by black and green polyethylene mulch were the best treatments of broad-leaved, grasses and total weeds control in both seasons.

Generally, black polyethylene soil mulch, hand hoeing (twice), Stomp extra(1.275 l./fed.) followed by one hoeing, Amex (1.875 l./fed.) followed by one hoeing, Stomp extra (1.7 l./fed.), Gesagard (1.125 l./fed.) followed by one hoeing, green polyethylene mulch were the best treatments of broad-leaved, grasses and total weeds in both seasons. Thus, for bio- Organic farming can be used black polyethylene mulch, hand hoeing (twice), and green polyethylene mulch in pea, while the rest can be used for treatments in the open cultivation. These results are in agreement with those found by Fakkar and El-Dakkak (2015).

3.2. Vegetative growth traits

All weed control treatments significantly affected plant height in both seasons (Table 4). The treatment of black polyethylene mulch gave the tallest plants followed by green and transparent polyethylene mulch treatment for plant height in both seasons, while followed Stomp extra(1.275 l./fed.) followed by one hoeing and Stomp extra (1.7 l./fed.). All weed control treatments significantly affected number of branches per plant in both seasons (Table 4). The treatment Stomp extra(1.275 l./fed.) followed by one hoeing had highest values in both seasons. Also, Amex (1.875 l/fed. 0 followed by one hoeing and Gesagard (1.5 l./fed.) treatments were high mean values in the first seasons while, Stomp extra (1.7 l./fed.) treatment was high mean value in the second season. The treatments of black polyethylene, green polyethylene and transparent polyethylene were the lowest mean values for number of branches per plant in both seasons. These results are in agreement with those found by Khan *et al.* (2003), El-Dakkak *et al.* (2010), Fakkar and El-Dakkak(2015) and Waseem *et al.* (2018). For mulching, the plant height increased with the mulch treatments (Table 4). The tallest plant was

Table (3): Effect of some herbicide and mulching treatments on fresh weight of weeds (g/m^2) of pea yield in 2015/2016 and 2016/2017 seasons.

Treatments & herbicide rate / fed.	Broad leaved weeds (g/m^2)	Controlling %	Grassy weeds (g/m^2)	Controlling %	Total weeds (g/m^2)	Controlling %
	2015\2016					
Amex at 2.5 l.	979.3 b	80.5	22.3 d	96.1	1001.6 d	82.0
Amex at 1.875 L. followed one hoeing	18.6 c	99.6	2.0 d	99.6	20.6 ef	99.6
Ultra afalon at 1 l.	1248.0 b	75.1	210.3 c	63.0	1458.3 c	73.9
Ultra afalon at 0.75l followed by one hoeing	115.3 c	97.7	3.0 d	99.5	118.3 ef	97.9
Stomp extra at 1.7l.	395.0 c	92.1	7.3 d	98.7	402.3 e	92.8
Stomp extra at 1.275 l. followed by one hoeing	9.6 c	99.8	1.0 d	99.8	10.6 f	99.8
Gesagard at 1.5 l.	1076.0 b	78.5	10.0 d	98.2	1086.0 d	80.5
Gesagard at 1.125 l.followed by one hoeing	29.0 c	99.4	3.3 d	99.4	32.3 ef	99.4
Black polyethylene mulch	22.3 c	99.6	1.0 d	99.8	23.3 ef	99.6
green polyethylene mulch	38.3 c	99.2	10.0 d	98.2	48.3 ef	99.1
Transparent polyethylene mulch	1332.0 b	73.4	1072.0 a	-88.7	2404.0 b	56.9
Hand hoeing (Twice)	54.0 c	98.9	12.0 d	97.9	66.0 ef	98.8
Unweeded	5012.0 a	0.0	568.0 b	0.0	5580.0 a	0.0
	2016\2017					
Amex at 2.5 l.	759.3 cd	83.5	34.7 d	94.4	794.0 cd	84.8
Amex at 1.875 l. followed one hoeing	100.0 d	97.8	6.3 d	99.0	106.3 d	98.0
Ultra afalon at 1 l.	830.7 c	81.9	258.3 c	58.5	1089.0 c	79.1
Ultra afalon at 0.75l followed by one hoeing	148.7 cd	96.8	8.6 d	98.6	157.3 d	97.0
Stomp extra at 1.7l.	432.7 cd	90.6	14.6 d	97.6	447.3 cd	91.4
Stomp extra at 1.275 l. followed by one hoeing	32.3 d	99.3	5.0 d	99.2	37.3 d	99.3
Gesagard at 1.5 l.	674.3 cd	85.3	25.3 d	95.9	699.6 cd	86.6
Gesagard at 1.125 l. followed by one hoeing	57.6 d	98.7	9.6 d	98.4	67.2 d	98.7
Black polyethylene mulch	28.3 d	99.4	4.0 d	99.4	32.3 d	99.4
green polyethylene mulch	58.3 d	98.7	9.7 d	98.4	68.0 d	98.7
Transparent polyethylene mulch	1747.0 b	61.9	1022.0 a	-64	2769.0 b	46.9
Hand hoeing (Twice)	59.6 d	98.7	22.7 d	96.4	82.3 d	98.4
Unweeded	4590.3 a	0.0	622.7 b	0.0	5213.0 a	0.0

Means followed by the same letters within each column do not differ significantly according to Duncan's Multiple Range test at the 5% level.

Table (4): Effect of some herbicide and mulching treatments on six traits of pea in 2015/2016 and 2016/2017 seasons.

Treatments & herbicide rate / fed.	Plant height (cm)	Number of branches/ plant	Pod length (cm)	Pod width (cm)	Number of seed/pod	100-green seed weight (g)
2015/2016						
Amex at 2.5 l.	81.5 de	3.0 ab	10.6 ab	1.1 bc	7.7 cd	46.2 bc
Amex at 1.875 l. followed one hoeing	85.3 d	3.5 a	9.6 cd	1.2 abc	7.1 cd	47.3 b
Ultra afalon at 1 l.	82.8 d	3.1 a	10.0 bc	1.2 abc	7.5 cd	45.7 bc
Ultra afalon at 0.75l. followed by one hoeing	81.5 de	2.8 ab	9.4 d	1.2 abc	7.0 cd	47.3 b
Stomp extra at 1.7L.	82.1 de	3.1 ab	11.0 a	1.3 ab	8.9 ab	49.4 a
Stomp extra at 1.275 l. followed by one hoeing	80.8 de	3.4 a	10.6 ab	1.2 abc	9.0 ab	51.4 a
Gesagard at 1.5 L.	64.0 fg	3.5 a	9.7 cd	1.4 a	6.8 d	44.9 cd
Gesagard at 1.125 L.followed by one hoeing	68.3 f	3.2 ab	9.2 d	1.3 ab	7.3 cd	46.2 bc
Black polyethylene mulch	112.8 a	2.1 b	11.2 a	1.3 ab	9.6 a	50.2 a
green polyethylene mulch	93.4 c	2.5 ab	9.2 d	1.3 ab	8.1 bc	49.4 a
Transparent polyethylene mulch	101.2 b	2.1 b	9.7 cd	1.2 abc	6.9 cd	43.6 d
Hand hoeing (Twice)	76.2 e	2.8 ab	10.1 bc	1.3 ab	7.4 cd	46.1 bc
Unweeded	61.4 g	2.8 ab	8.2 e	1.1 c	5.4 e	39.1 e
2016/2017						
Amex at 2.5 l.	80.1 ef	3.0 d	10.6 b	1.3 ab	7.6 cd	45.5 defg
Amex at 1.875 l. followed one hoeing	88.3 cd	3.6 abc	9.6 c	1.3 ab	6.8 cde	47.3 bcd
Ultra afalon at 1 l.	78.7 ef	3.1 bcd	9.9 bc	1.1 cd	6.3 def	45.3 efg
Ultra afalon at 0.75l followed by one hoeing	82.5 de	3.0 cd	10.1 bc	1.3 abc	7.1 cde	47.1 cde
Stomp extra at 1.7l.	90.5 c	3.7 a	11.9 a	1.4 ab	7.9 bc	49.1 ab
Stomp extra at 1.275 l. followed by one hoeing	90.9 c	3.6 ab	11.5 a	1.4 ab	9.1 ab	50.2 a
Gesagard at 1.5 l.	64.1 g	3.4 abcd	9.6 c	1.5 a	7.7 cd	44.9 fg
Gesagard at 1.125 L.followed by one hoeing	67.1 g	3.5 abcd	9.8 bc	1.3 abc	7.3 cde	45.5 defg
Black polyethylene mulch	110.7 a	2.2 e	12.0 a	1.3 ab	9.7 a	49.8 a
green polyethylene mulch	92.3 c	2.2 e	10.3 bc	1.4 ab	7.7 c	48.8 abc
Transparent polyethylene mulch	101.4 b	2.2 e	9.8 bc	1.2 bcd	6.2 ef	44.0 g
Hand hoeing (Twice)	75.4 f	3.0 cd	10.3 bc	1.3 ab	7.5 cde	46.0 def
Unweeded	61.1 g	3.2 abcd	8.1 d	1.0 d	5.3 f	38.8 h

Means followed by the same letters within each column do not differ significantly according to Duncan's Multiple Range test at the 5% level.

recorded in crop mulched with black, green and transparent polyethylene and the shortest plant was found in the untreated check. The black, green and transparent polyethylene mulched plant maintained slightly lower number of primary branches, However, the variation between the treatments was found insignificant. Similar findings were reported for mulching in pea by Waseem *et al.* (2018) and Awal *et al.* (2016) who found that mulches change the soil temperature and moisture content, which might favor vigorous growth and resulted taller plants than the plants grown with no mulch.

3.3. Pea yield and yield components

Some important yield attributes of pea such as pod length, pod width, number of seeds per pod, fresh pod weight, fresh seed weight per pod, shell out % and 100- green seed weight showed significant differences for different treatments (Tables 4 and 5). For pod length, significant differences were found between all treatments. The treatments of black polyethylene mulch, Stomp extra (1.7 l./fed.) and Stomp extra (1.275 l./fed.) followed by one hoeing gave the highest mean values in both seasons followed by Amex (2.5 l./fed.) treatment in the first season. For pod width, nonsignificant was found all treatments except unweeded check control and Amex (2.5 l./fed.) in effect first season and Ultra afalon (1 l./fed.) in the second season. For number of seeds/pod, significant was found between all treatments. Black polyethylene mulch, Stomp extra (1.7 l./fed.) and Stomp extra(1.275 l/fed.) followed by one hoeing treatments were the highest mean values in both seasons. For pod weight, the treatments black polyethylene mulch, Amex (1.875 l./fed. 0 followed one hoeing, Ultra afalon(0.75 l./fed.) followed one hoeing, Stomp extra (1.7 l./fed.),Stomp extra (1.275l/fed.) followed by one hoeing and Gesagard (1.125 l./fed.) followed by one hoeing were the highest mean values in both seasons. For fresh seed weight/pod Stomp extra (1.7 l./fed.) and Ultra afalon (0.75 l./fed.) followed by one hoeing treatments were the highest mean values in both seasons while, Amex (1.875 l./fed.) followed by one hoeing and Gesagard (1.125 l./fed.) followed by one hoeing were the highest in first season, also black polyethylene mulch, Stomp extra (1.7 l./fed.) and Amex (2.5 l./fed.) were the highest in the second season. For shell out %, nonsignificant result was found in all treatments. The treatment Stomp extra (1.7 l./fed.) gave the highest mean values in both seasons. For 100-green seed weight, Stomp extra (1.275 l./fed.) followed by one hoeing, black polyethylene mulch, Stomp extra (1.7 l./fed.) and green polyethylene mulch were the highest mean values in both seasons.

For mulching, green pod yield /fed. and dry seed yield/fed. Stomp extra (1.275 l./fed.) followed one hoeing, black polyethylene mulch, hand hoeing (twice), Stomp extra (1.7 L./fed.), Gesagard(1.125 l./fed.)followed one hoeing, Ultra afalon (0.75 l./fed.) followed by one hoeing and Amex (1.875 l./fed.) followed by one hoeing treatments gave the highest green pod and dry seed yield. For protein %, nonsignificant was found of all treatments while the treatments Stomp extra (1.275l./fed.) followed one hoeing and Stomp extra (1.7 l./fed.) gave high mean values. Fakkar and El-Dakkak (2015) found that weed control treatments significantly increased pea yield and its components in both seasons. DAS (2016) found that the highest seed yield was recorded under the treatment of hand weeding twice and the lowest with weedy check.

Some important yield attributes of pea such as pod length, pod width, fresh seed per pod, fresh pod weight, fresh seed weight per pod, shell out % and 100- green seed weight showed significant differences for the different mulches used (Tables 4 and 5). Black, green and transparent polyethylene mulched plants exhibited the highest values of those traits. The higher values of pod length and width were obtained from the plants grown with black or transparent polyethylene mulch compared to the plants grown with no mulch condition (Table 4). Black polyethylene mulch suppressed weed growth whereas transparent polyethylene mulch enhanced it. Plant height, pod length, pod width, fresh seed per pod, fresh pod weight, fresh seed weight per pod, shell out %, 100- green seed weight, fresh pod yield and dry seed yield were maximum in plants mulched with both black or green polyethylene. There was a remarkable variation in fresh pod yield/fed. and dry seed yield/fed. due to the application of different mulch materials to the pea crop (Table 5). The highest fresh pod yield and dry seed yield/fed. were observed from the crops grown with black and green polyethylene mulch and the lowest yields were noticed in transparent mulch. Since black polyethylene mulch suppressed weed growth and ensured higher yield, it would be the best mulch. Therefore, black polyethylene can be recommended as an effective mulching material for the better yield of pea. Similar results were also reported by Tamana *et al.* (2009),

Table (5): Effect of some herbicide and mulching treatments on six traits of pea in 2015/2016 and 2016/2017 seasons.

Treatments & herbicide rate / fed.	Green pod weight (g)	Green seed weight/ pod (g)	Shell out %	Green pod yield (ton/fed.)*	Dry seed yield (kg/fed.)	Protein (%)
2015/2016						
Amex at 2.5 l.	8.0 b	4.6 ab	57.8 a	6.1 d	619.6 e	22.5 d
Amex at 1.875 l. followed one hoeing	9.5 a	4.7 a	50.2 ab	6.6 c	740.9 b	22.6 cd
Ultra afalon at 1 l.	7.7 bc	4.1 c	53.4 ab	6.6 c	608.6 e	23.2 abc
Ultra afalon at 0.75l. followed by one hoeing	9.4 a	4.9 a	52.8 ab	7.1 b	753.8 b	23.0 abcd
Stomp extra at 1.7l.	9.1 a	4.6 ab	51.4 ab	7.3 b	678.7 cd	23.4 a
Stomp extra at 1.275 l. followed by one hoeing	9.0 a	4.7 a	53.1 ab	7.7 a	875.6 a	23.3 ab
Gesagard at 1.5 l.	8.0 b	4.3 bc	53.5 ab	6.1 d	650.1 de	22.5 d
Gesagard at 1.125 l. followed by one hoeing	9.1 a	4.7 a	52.3 ab	7.2 b	839.9 a	22.9 abcd
Black polyethylene mulch	9.4 a	4.6 ab	49.1 b	7.2 b	723.3 bc	22.9 abcd
green polyethylene mulch	7.8 bc	4.2 bc	54.1 ab	6.1 d	531.7 f	23.1 abcd
Transparent polyethylene mulch	9.1 a	4.6 ab	51.4 ab	5.2 e	422.8 g	22.9 abcd
Hand hoeing (Twice)	8.2 b	4.1 c	49.9 ab	7.3 b	728.3 b	23.1 abcd
Unweeded	7.2 c	3.4 d	48.3 b	3.2 f	313.3 h	22.7 bcd
2016/2017						
Amex at 2.5 l.	8.0 def	4.5 abc	57.1a	6.0 ef	599.2 e	23.4 ab
Amex at 1.875 l. followed one hoeing	9.4 ab	4.3 bc	46.4 b	6.5 bcde	710.3 c	22.9 ab
Ultra afalon at 1 l.	7.6 fg	4.1 cd	53.6 ab	6.5 cde	563.6 ef	23.3 ab
Ultra afalon at 0.75l followed by one hoeing	8.9 abc	4.6 abc	51.5 ab	7.1 abc	726.7 c	23.2 ab
Stomp extra at 1.7l.	9.1 abc	4.6 abc	51.3 ab	7.3 a	690.0 c	23.5 a
Stomp extra at 1.275 l. followed by one hoeing	8.9 abcd	4.9 ab	55.6 a	7.7 a	880.0 a	23.4 ab
Gesagard at 1.5 l.	7.8 ef	4.2 cd	53.8 ab	5.8 ef	641.7 d	22.8 b
Gesagard at 1.125 l. followed by one hoeing	9.2 ab	4.3 bc	47.3 b	7.0 abcd	834.0 b	22.8 b
Black polyethylene mulch	9.7 a	5.1 a	52.3 ab	7.3 a	723.3 c	23.3 ab
green polyethylene mulch	8.2 cdef	4.3 bc	53.4 ab	6.3 def	536.8 f	23.2 ab
Transparent polyethylene mulch	8.7 bcde	4.4 bc	51.5 ab	5.7 f	453.3 g	23.3 ab
Hand hoeing (Twice)	8.2 cdef	4.1 cd	49.7 ab	7.2 ab	730.0 c	22.8 b
Unweeded	6.8 g	3.6 d	53.1 ab	3.3 g	276.7 h	23.1 ab

Means followed by the same letters within each column do not differ significantly according to Duncan's Multiple Range test at the 5% level. ***total of three harvesting**

Awal *et al.* (2016) and Waseem *et al.* (2018).

Generally, black polyethylene mulch, Stomp extra (1.275 l./fed.) followed by one hoeing and hand hoeing (twice) were the best for most traits in both seasons followed by Stomp extra (1.7 l./fed.) and Gesagard (1.125 l./fed.) followed by one hoeing treatments. These results mean that pea production is highly affected by weed existence and pea growers should plan weed management strategies using weed control for increasing production of pea yield. These results are in agreement with obtained by Khan *et al.* (2003), El-Dakkak *et al.* (2010), Fakkar and El-Dakkak (2015) and Waseem *et al.*(2018).

3.4. Herbicides residues determination

Results in (Table 6 and Figs 1 - 4) show that the residues of applied herbicides in green pea seeds crop collected at 80 days from sowing were lower than their maximum residual level herbicides which make the herbicide is quicker dissipated in soil in another side. These herbicides can be degradation depends on the soil microbe's population and their activity, soil constituent *e.g.* organic matter and clay. Apart from these factors, soil pH, temperature and other environmental conditions, which play important roles in pesticide degradation. These results are in agreement with obtained by Sondhia (2013) who indicated that residues of pendimethalin in green pea was found below the maximum residue limit which was set by EPA (0.05 μg^{-1}) and reported that pendimethalin residues 0.017, 0.013 and 0.011 μg^{-1} were found in green pea collected at 45 days at 750, 350, and 185 g *a.i.* ha^{-1} treatments, respectively. Hassanein *et al.* (2014) found that there was no residues existed for pendimethalin, butralin and merabuzin herbicides in tomato fruits.

Table (6): Residues for Amex (butralin), Ultra afalon(linuron), Stomp extra(pendimethalin) and Gesagard (Prometryn) in green pea seeds.

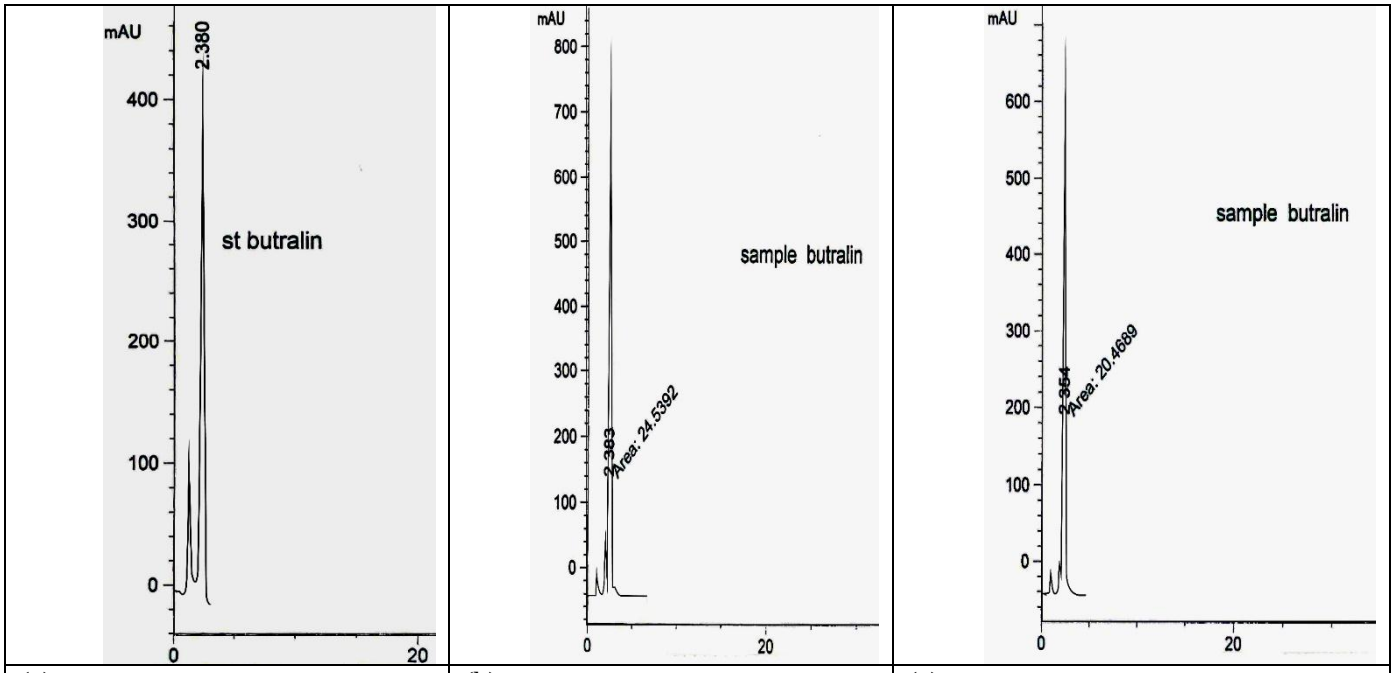
Herbicides & rate / fed.	Retention time	Herbicide residues µg /g (ppm)	Maximum residue level (MRL) µg /g ppm
Amex48%(butralin) at 2.5 l.	**2.383**	**0.006982**	**0.01**
Amex48%(butralin) at 1.875 l. followed one hoeing	**2.354**	**0.005824**	**0.01**
Ultra afalon 45 % (linuron) at 1 l.	**3.800**	**0.02991**	**0.50**
Ultra afalon 45 % (linuron) at 0.75L followed by one hoeing	**3.795**	**0.00847**	**0.50**
Stomp extra 45.5 % (pendimethalin) at 1.7l.	**3.640**	**0.00813**	**0.02**
Stomp extra 45.5 % (pendimethalin) at 1.275 l. followed by one hoeing	**3.446**	**0.00667**	**0.02**
Gesagard 50% (Prometryn) at 1.5 l.	**1.818**	**0.07506**	**0.50**
Gesagard 50% (Prometryn) at 1.125 l. followed by one hoeing	**1.832**	**0.03055**	**0.50**

(MRL) allowed by as set by EU 0.01 µg /g for Amex 48% (butralin) at 2.5 l./fed. 0.006982 µg/g while Amex 48% (butralin) followed by one hoeing 0.005824 µg/g, 0.5 ppm for Ultra afalon 45% (linuron) at 1.0 l.\fed. 0.02991 µg /g while Ultra afalon 45% (linuron) followed by one hoeing 0.00847µg/g, 0.02 µg/g for Stomp extra 45.5% (pendimethalin) at 1.7 l.\fed. 0.00813µg/g while Stomp extra 45.5 % (pendimethalin) followed by one hoeing 0.00667 µg /g and 0.5 µg/g for Gesagard 50%(Prometryn) at 1.5 l.\fed. 0.07506 µg/g while Gesagard 50% (Prometryn) followed by one hoeing 0.03055 µg/g. Both Ultra aflon or Gesagard residues in grain seeds of pea were lower than those of Stomp extra or Amex in one side and adding additional hand hoeing after 40 days from sowing with reduced rates of these herbicide had lower residues which may be due the role of hoeing in breaking

3.5. Correlation between weight of broad leaved, grassy weeds and total weeds with yield and yield components

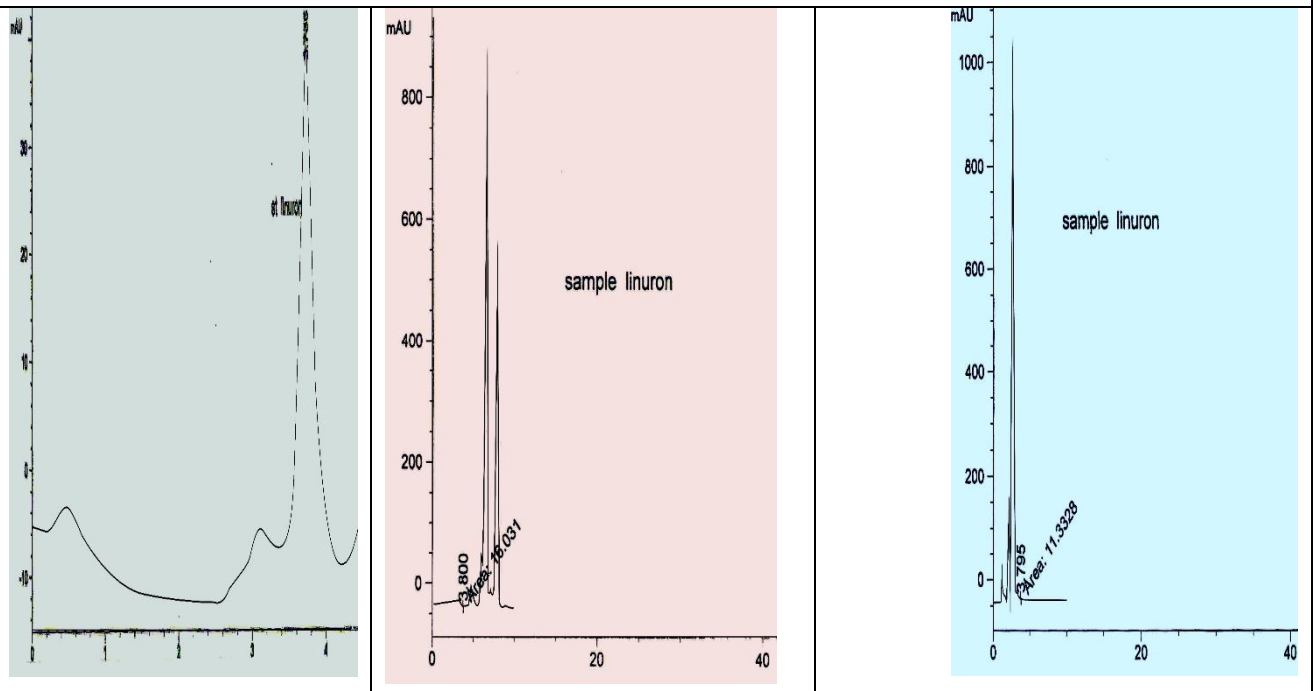
Table (7) show that the correlation coefficients between total weeds and yield, yield components during 2015/2016 and 2016/2017 seasons. Correlation coefficients between broad leaved, grassy weeds and total weeds with pod length, pod width, number of seeds/pod,100-green seed weight, fresh pod weight, fresh seed weight/pod, fresh pod yield and dry seed yield were negative and highly significant at 1% level in both seasons.

While, correlation coefficients between broad leaved, grassy weeds and total weeds with plant height are significant at 5% level in both seasons except grassy weeds were nonsignificant in both seasons. On the other hand, correlation coefficients between broad leaved, grassy weeds



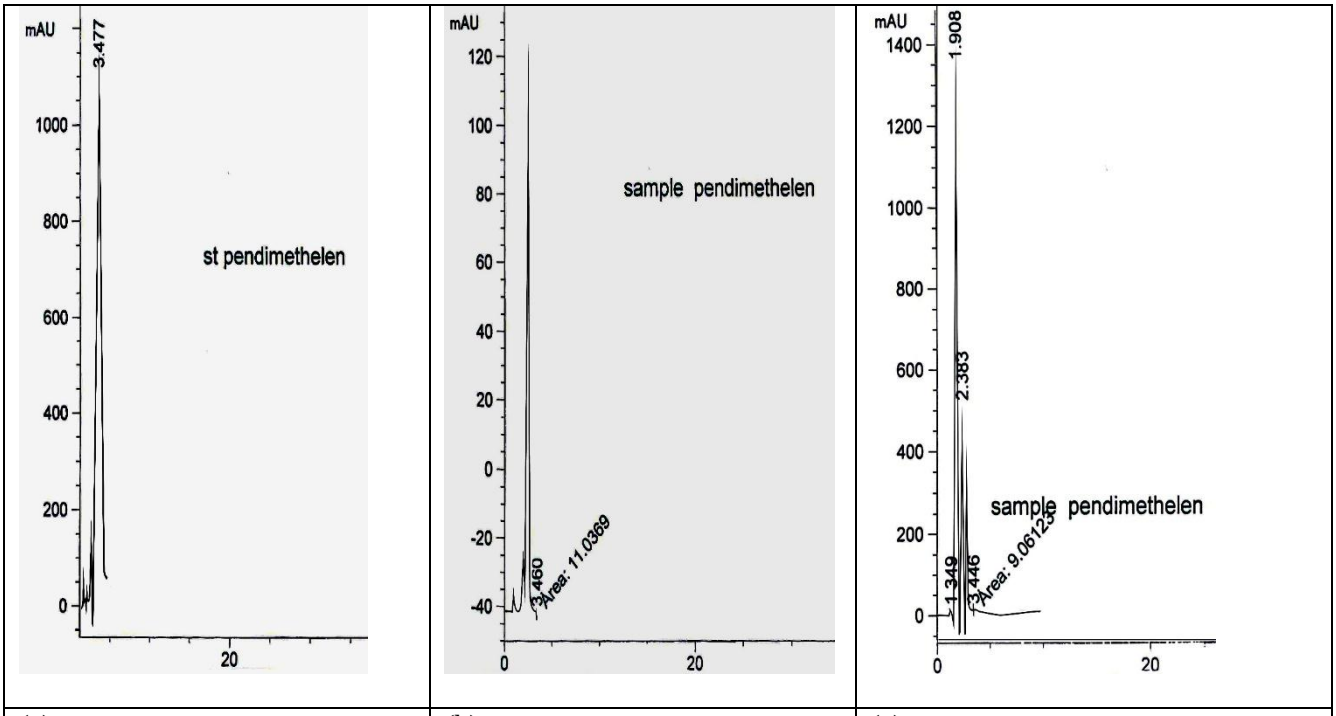
(a) (b) (c)

Fig. (1): (a) Chromatogram of standard of Amex (butralin) ; (b) Chromatogram of sample Amex (butralin) at 2.5 l./ fed. in pea seeds and(c) Chromatogram of sample butralin at 1.875 l./ fed. followed by one hoeing in pea seeds.



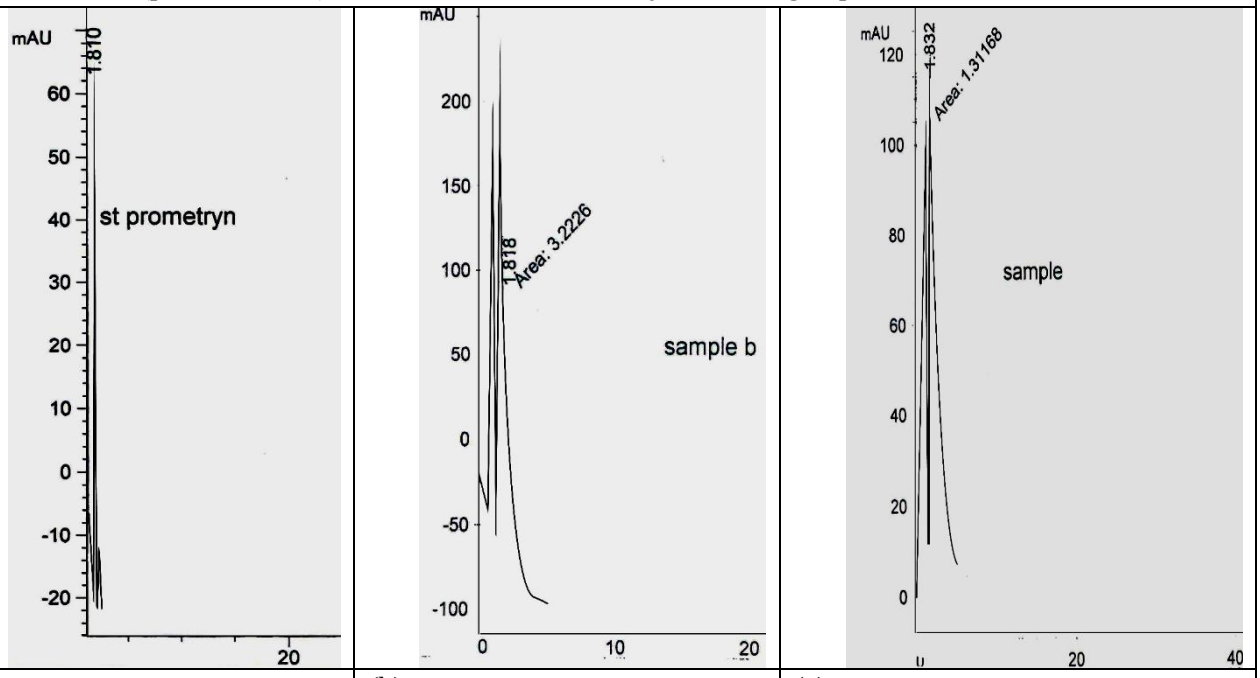
(a) (b) (c)

Fig. (2) : (a) Chromatogram of standard of Ultra afalon (linuron); (b) chromatogram of sample Ultra afalon (linuron) at 1.0 l./ fed. in pea seeds and (c) chromatogram of sample Ultra afalon (linuron)at 0.750 l./ fed. followed by one hoeing in pea seeds.



(a) (b) (c)

Fig. (3) : (a) Chromatogram of standard of Stomp extra (pendimethalin); (b): Chromatogram of sample Stomp extra (pendimethalin) at 1.7 l. / fed in pea seeds and(c) Chromatogram of sample Stomp extra (pendimethalin) at 1.275 l./ fed. followed by one hoeing in pea seeds.



(a) (b) (c)

Fig. (4): (a) Chromatogram of standard of Gesagard (Prometryn); (b): Chromatogram of sample Gesagard (Prometryn) at 1.5 l./ fed. in pea seeds (c) Chromatogram of sample Gesagard (Prometryn) at 1.125 l./ fed. followed by one hoeing in pea seeds.

Table (7): Correlation between weight of Broad leaved, Grassy weeds and total weeds with yield and yield components in pea duration 2015/2016 and 2016/2017 seasons.

Seasons	2015/2016			2016/2017		
Traits	Broad leaved weeds (g/m^2)	Grassy weeds (g/m^2)	Total weeds (g/m^2) 2015/2016	Broad leaved weeds (g/m^2)	Grassy weeds (g/m^2)	Total weeds (g/m^2) 2016/2017
Plant height	-0.418**	0.142	-0.335*	-0.387*	0.053	-0.316*
Number of branches/plant	-0.071	-0.306	-0.143	-0.041	-0.300	-0.096
Pod length	-0.537**	-0.343*	-0.538**	-0.595**	-0.454**	-0.596**
Pod width	-0.416**	-0.439**	-0.411**	-0.633**	-0.548**	-0.647**
Number of seed/pod	-0.593**	-0.407**	-0.600**	-0.586**	-0.570**	-0.612**
100-green seed weight	-0.802**	-0.615**	-0.824**	-0.841**	-0.627**	-0.839**
Green pod weight (g)	-0.584**	-0.357*	-0.540**	-0.595**	-0.314*	-0.566**
Green seed weight/pod	-0.656**	-0.244	-0.621**	-0.539**	-0.283	-0.513**
Shell out %	-0.143	-0.145	-0.154	0.162	0.077	0.153
Green pod yield	-0.889**	-0.665**	-0.911**	-0.849**	-0.584**	-0.836**
Dry seed yield	-0.782**	-0.720**	-0.829**	-0.819**	-0.710**	-0.837**
Protein (%)	-0.235	-0.094	-0.224	-0.068	-0.081	-0.074

and total weeds with number of branches/plant, Shell out % and protein content (%) are nonsignificant in both seasons. Correlation coefficients between total weeds and all traits were negative in both seasons. Sowing that pea crop productivity several affected by weed compotation. Fakkar and El-Dakkak (2015) found that 100-green seed weight and both green pod yield and dry seed yield were significantly negatively correlated with weight of grassy, broad-leaved and total weeds.

3.6. Phenotypic correlation among the studied traits

Phenotypic correlation coefficients for all comparisons among the studied traits are presented in Table (8) which show that fresh pod yield was positively and significantly correlated with each of plant height, pod length, pod width, number of seed/pod, fresh pod weight, fresh seed weight/pod ,100-green seed weight and dry seed yield in both seasons. A Significant positive correlation was observed dry seed yield with each of plant height, number of branches/plants, pod length, pod width, number of seed/pod, fresh pod weight, fresh seed weight/pod ,100-green seed weight and fresh pod yield in both seasons. Significant positive correlation was detected between plant height with pod length, number of seed/pod, number of seed/pod, fresh pod weight, fresh seed weight/pod, 100-green seed weight and fresh pod yield. Significant positive correlation was detected between number of branches/plant with dry seed yield. Significant positive correlation was observed between pod length with plant height, pod width, number of seed/pod, fresh pod weight, fresh seed weight/pod, 100-green seed weight, fresh pod yield and dry seed yield. Also, significant positive correlation was observed between pod width with pod length, number of seeds/pod, 100-green seed weight, fresh pod yield and dry seed yield. Significant positive correlation was observed between number of seeds/pod with plant height, pod length, pod width, fresh pod weight, fresh seed weight/pod, 100-green seed weight and fresh pod yield. Significant positive correlation was observed between fresh pod weight with plant height, pod length, number of seeds/pod, fresh seed weight/pod,100-green seed weight, fresh pod yield and dry seed yield. Significant positive correlation was observed between fresh seed weight/pod with plant height, pod length, number of seeds/pod, fresh pod weight, shell out %, 100-green seed weight, fresh pod yield and dry seed yield. Significant positive correlation was observed between shell out %, with fresh seed weight/pod. Significant positive correlation was observed between 100-green seed weight with plant height, pod length, number of seeds/pod, fresh pod weight, fresh seed weight/pod, shell out %, protein (%) , fresh pod yield and dry seed yield. Significant positive correlation was observed between protein (%)

Table (8): Correlation coefficients among different pairs of characters in pea during 2015/2016 and 2016/2017 seasons.

Traits	Plant height	Number of branches /plant	Pod length	Pod width	Number of seeds/pod	Green pod weight	Green seed weight/pod	Shell out %	100-green seed weight	Green pod yield	Dry seed yield	Protein (%)
	2015/2016											
Plant height	-	-0.52**	0.50**	0.27	0.59**	0.43**	0.34*	-0.08	0.46**	0.36*	0.02	0.14
Number of branches/plant		-	0.07	0.50	-0.01	0.05	0.11	-0.02	0.10	0.20	0.35*	0.06
Pod length			-	0.35*	0.77**	0.40**	0.38*	-0.02	0.65**	0.63**	0.44**	0.31*
Pod width				-	0.46**	0.23	0.11	-0.11	0.38*	0.39*	0.59**	0.17
Number of seeds/pod					-	0.42**	0.38*	-0.01	0.79**	0.67**	0.50**	0.39*
Fresh pod weight						-	0.67**	-0.19	0.50**	0.56**	0.57**	0.25
Fresh seed weight/pod							-	0.32*	0.56**	0.60**	0.59**	0.05
Shell out %								-	0.15	0.11	0.12	0.09
100-green seed weight									-	0.81**	0.68**	0.38*
Fresh pod yield										-	0.90**	0.35*
Dry seed yield											-	0.19
	2016/2017											
Plant height	-	-0.47**	0.60**	0.23	0.46**	0.58**	0.63**	0.01	0.62**	0.44**	0.18	0.35*
Number of branches/plant		-	0.04	0.08	-0.05	-0.01	-0.12	-0.06	-0.01	0.14	0.35*	0.03
Pod length			-	0.46**	0.73**	0.52**	0.63**	0.05	0.76**	0.75**	0.59**	0.28
Pod width				-	0.51**	0.37*	0.50**	0.03	0.61**	0.48**	0.57**	0.01
Number of seeds/pod					-	0.50**	0.58**	0.04	0.73**	0.64**	0.63**	0.22
Fresh pod weight						-	0.63**	-0.23	0.68**	0.64**	0.64**	0.04
Fresh seed weight/pod							-	0.11	0.72**	0.55**	0.53**	0.12
Shell out %								-	0.05	0.10	0.17	0.13
100-green seed weight									-	0.81**	0.72**	0.12
Fresh pod yield										-	0.85**	0.24
Dry seed yield											-	0.08

with 100-green seed weight, pod length, number of seeds/pod and fresh pod yield in first season while was observed with plant height in second season. In contrast, significant negative correlations were observed between plant height with number of branches/plant in both seasons.

Correlation studies generally indicated that plant height, pod length, pod width, number of seed/pod, fresh pod weight, fresh seed weight/pod and 100-green seed weight were positively and significantly correlated with fresh pod yield and dry seed yield, indicating the importance of these traits as increase yield. These results are in harmony with those previously obtained by Fakkar and El-Dakkak (2015) who found that a significant positive correlation between 100-green-seed weight and both green pod yield and dry seed yield. Shukla (2015) found that correlation coefficient of seed yield per plant was recorded highly significant and positive with the number of hundred seed weight. Kannoj (2016) found that correlation coefficient analysis of seed yield/plant was recorded highly significant and positive with, pod length and number of seeds/pod. Galal *et al.* (2019) who found that pod weight/plant was

significantly positively correlated with each of plant height, pod width and pod weight.

3.7. Economic feasibility

Data in Table (9) shows that the effect of some weed control methods for pod pea during 2015/2016 and 2016/2017 seasons *i.e.* hand hoeing (twice), black, green, transparent polyethylene mulch and chemical methods on economic reburns of such used weed control treatments on pea. The highest gross margin (L.E/fed.) gives by the treatments Stomp extra(1.275 l./fed.) followed one hoeing, Stomp extra (1.7 l./fed.), Hand hoeing (twice), Gesagard (1.125 l./fed.)followed by one hoeing and black polyethylene mulch in both seasons. The total cost of applying of black, green and transparent polyethylene mulches were more constable as with other treatments, while Gesagard (1.5 l.), Ultra afalon (1 l.) and Stomp extra (1.7 l./fed.) were the lower compared with other treatments. Such treatments are economically for pea producers. Differences between all economic studied criteria to determine the economic feasibility of pods pea growing for weed control treatments in 2015/2016 and 2016/2017 winter seasons. The total cost, which calculated 14.000 L.E in both season included fixed cost (land preparation, seeds planting, post sowing activities, fertilization, irrigation, insect, harvesting and rental costs per fed.). These increases in gross income due to increasing pods yield/fed. by decreasing weed interference with pea crop. Grosse income of pods pea yields (LE/ fed.) increased with the use of herbicides than unweeded (control). Production costs involved

Table (9): Economic evaluation of the effect of some mulching and herbicide treatments for total pods yield during 2015/2016 and 2016/2017 seasons.

No.	Treatments	Mean pods yield (ton/fed.)	Gross income (L.E/fed.)	Total costs (L.E/fed.)	Net income (L.E/fed.)	Profitability %	Benefit / costs ratio
		2015\2016					
1	Amex at 2.5 l.	6.10	24400	14750	9650	65.4	1.7
5	Amex at 1.875 l. followed one hoeing	7.33	29200	14500	14700	101.3	2.1
6	Ultra afalon at 1 l.	7.73	30800	15000	15800	105.3	2.2
7	Ultra afalon at 0.75l. followed by one hoeing	6.07	24400	14350	10050	70.0	1.7
8	Stomp extra at 1.7l.	7.20	28800	14900	13900	93.2	2.0
9	Stomp extra at 1.275 l. followed by one hoeing	7.23	28800	16000	12800	80.0	2.1
10	Gesagard at 1.5 l.	6.13	24400	15500	8900	57.4	1.8
11	Gesagard at 1.125 l. followed by one hoeing	5.20	20800	15500	5300	34.1	1.6
12	Black polyethylene mulch	7.30	29200	15200	14000	92.1	2.0
13	green polyethylene mulch	3.20	12800	14000	-1200	-8.5	0.9
		2016\2017					
1	Amex at 2.5 l.	6.03	24000	14750	9250	62.7	1.6
2	Amex at 1.875 l. followed one hoeing	6.57	26000	15200	10800	71.0	1.7
3	Ultra afalon at 1 l.	6.50	26000	14400	11600	80.5	1.8
4	Ultra afalon at 0.75l. followed by one hoeing	7.1 0	28400	15000	13400	89.3	1.8
5	Stomp extra at 1.7l.	7.30	29200	14500	14700	101.3	2.0
6	Stomp extra at 1.275 l. followed by one hoeing	7.73	30800	15000	15800	105.3	2.0
7	Gesagard at 1.5 l.	5.87	23200	14350	8850	61.6	1.6
8	Gesagard at 1.125 l.followed by one hoeing	7.03	28000	14900	13100	87.9	1.8
9	Black polyethylene mulch	7.37	29200	16000	13200	82.5	1.8
10	green polyethylene mulch	6.37	25200	15500	9700	62.5	1.6
11	Transparent polyethylene mulch	5.73	22800	15500	7300	47.1	1.4
12	Hand hoeing (Twice)	7.27	28800	15200	13600	89.4	1.8
13	Unweeded	3.37	13200	14000	-800	-5.7	0.9

*Note that the prices are approximate in the two seasons for costs and gross.

costs of field operations, labor, materials and harvesting as well as land rent. The total estimated cost of production per one feddan of pea was 14.000.0 L.E for pods yield. The cost of black polyethylene mulch, green polyethylene mulch, Transparent polyethylene mulch, Hand hoeing (twice) and Amex (1.875 l./fed.) followed by one hoeing were the highest input category . The highest net income for the treatments was obtained by Stomp extra(1.275 l./fed.) followed one hoeing, Stomp extra (1.7 l../fed.) and Hand hoeing (twice) treatments in both seasons. Unweeded (control) treatment had negative sign for the net return parameter in both seasons. These racer delay to extreme negative effects of weed competition to pea and weed control is should take in constitution crucial in improving pea crop management and farmers The grower could earn a profitability rate of (ranged from 105.3 to 89.1%) for Stomp extra(1.275 l./fed.) followed one hoeing, Stomp extra (1.7 l./fed.) and Hand hoeing (Twice) treatments in both seasons. Gross income (L.E/fed.) was the highest by the treatments Stomp extra(1.275 l./fed.) followed one hoeing, Stomp extra (1.7 l./fed.), Hand hoeing (Twice) and black polyethylene mulch in both seasons.

In economic evaluation, this study showed that pods pea yield is a profitable enterprise when used the treatments Stomp extra(1.275 l./fed.) followed one hoeing, Stomp extra (1.7 l./fed.), Hand hoeing (Twice) and black polyethylene mulch in both seasons.

Conclusions

From the above mentioned results, it could be concluded that some alternative mechanical weed control hand hoeing (twice), mulching by black polyethylene or reduced rate of Stomp extra (1.275 l./fed.) integrated one hoeing can be used Stomp extra (1.7 l./fed.) full rate of as safe alternative for weed control in pea to produce good vegetable yield without any herbicidal residues in green seeds of these herbicides. Such weed control treatments can be used fairly in organic farming conditions in Egypt.

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تأثير بعض مبيدات الحشائش ومعاملات التغطية بالبلاستيك كبدائل طبيعية لمكافحة الحشائش وإنتاجية البسلة مع اقتفاء متبقيات المبيدات بالبذور

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ملخص

أجريت هذه التجربة بمحطة بحوث البساتين بسدس التابعة لمركز البحوث الزراعية بمحافظة بنى سويف بمصر وذلك خلال الموسمين الشتويين لعام 2016/2015 وعام 2017/2016 بهدف دراسة تأثير ثلاثة عشر معاملة لمكافحة الحشائش بمبيدات الحشائش أو باستخدام التغطية بانواع مختلفة من البلاستيك. وهذه المعاملات هى: اميكس بمعدل 2.5 لتر للفدان، اميكس بمعدل 1.875 لتر للفدان مع اجراء عزيق مرة واحدة بعد 40 يوم من الزراعة ، الترا افالون بمعدل 1 لتر للفدان ،الترا افالون بمعدل 0.750 لتر للفدان مع اجراء عزيق مرة واحدة بعد 40 يوم من الزراعة ، ستومب اكسترا بمعدل 1.7 لتر للفدان ، ستومب اكسترا بمعدل 1.275 لتر للفدان مع اجراء عزيق مرة واحدة بعد 40 يوم من الزراعة ، جيساجارد بمعدل 1.5 لتر للفدان ، جيساجارد بمعدل 1.125 لتر للفدان مع اجراء عزيق مرة واحدة بعد 40 يوم من الزراعة ، تغطية التربة بالبلاستيك الأسود ، تغطية التربة بالبلاستيك الأخضر، تغطية التربة بالبلاستيك الشفاف ، العزيق مرتين الاولى بعد 20 يوم من الزراعة والثانية بعد 40 يوم من الزراعة مقارنة بالكنترول (بدون رش وبدون عزيق) وذلك علي محصول البسلة ومكوناته والحشائش المصاحبة له فى تصميم قطاعات كاملة العشوائية وتم تقدير الاثر المتبقى لمبيدات الحشائش فى بذور البسلة الخضراء باستخدام جهاز HPLC.

اوضحت النتائج ان افضل المعاملات فى مكافحة مجموعة الحشائش الحولية سواء عريضة الاوراق أوالنجيلية والمحصول العالى هى التغطية بالبلاستيك الاسود أوالبلاستيك الاخضر حيث ارتبطت سلبيا مع كمية الحشائش وارتبطت ايجابيا مع المحصول ومكوناته فى البسلة وتفوقت على جميع المبيدات المستخدمة منفردة مثل الاميكس والالترا افالون ,الاستومب اكسترا والجيساجارد وتساوت تقريبا او تفوقت على استخدام المعدلات المنخفضة من هذه المبيدات متبوعة بعزقة . تم تقدير متبقيات المبيدات المستخدمة وكانت اقل من الحد المسموح به دوليا. كانت متبقيات المبيدات فى المعدلات المنخفضة من هذه المبيدات متبوعة بعزقة اقل من المعدلات العالية للمبيدات منفردة كما ان مبيدى الترا افالون وجيساجارد كانت متبقيات المبيدات بالبذور الخضراء اقل من المبيدات الاميكس والاستومب اكسترا. من النتائج وجد ان معاملتى ستومب اكسترا بمعدل 1.275 لتر للفدان مع عزقة واحدة والتغطية بالبلاستيك الاسود كانت الافضل فى نسبة الابادة للحشائش الحولية الكلية والمحصول فى كلا الموسمين. اظهرت النتائج ايضا وجود ارتباط معنوى سالب بين وزن الحشائش الكلى مع محصول القرون الخضراء ومحصول البذور. كانت المعاملات التالية جيساجارد متبوعة بعزقة وستومب اكسترا متبوعة بعزقة والتغطية بالبلاستيك الاسود الافضل اقتصاديا من باقى المعاملات. من النتائج المتحصل عليها يمكن التوصية ايضا باستخدام تغطية التربة بالبلاستيك الاسود والاخضر كبديل اقتصادي ونظيف بيئيا فى زراعات البسلة المنتجة تحت انظمة الزراعة العضوية .

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