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# ALLELOPATHIC CAPABILITY OF SOME PLANT FAMILIES ON SAFE WEED CONTROL IN CERTAIN CROPS

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## ABSTRACT

Some plant families (Fabaceae,Asteraceae, Brassicaceae, Poaceae, Solenaceae, Cucurbitaceae....) have different allelopathic capability to produce and exude allelochemicals into their environments to suppress the growth of annual weeds in their surrounding area. In this study, wheat (*Triticum aestivum* L.), corn (*Zea mays* L.) and their associated annual weeds were exposed to the allelochemicals arised from their previousing crops during the crop rotation. The summer crops prior to wheat were maize, sorghum, panicum, alfalfa, cowpea, sunflower. While the winter crops prior to maize were safflower, barley, canola, rye, oat, wheat, respectively. For this target two field experiments were conducted at Maryout Experimental Station, Desert Research Center during 2003-2005 winter and summer seasons.

Weed species associated to wheat exhibited substantial significant reduction in its fresh and dry weights as a result of growing wheat subsequent to maize, sorghum, alfalfa, sunflower, panicum and cowpea, respectively. Wheat grain yield and biological yield showed significant increases with the same species order after the decomposition period of crop residues. .

The fresh and dry weights of weed species associated to maize were reduced significantly by sowing maize subsequent to wheat, barley, oat, rye and safflower, respectively. Maize grain yield and biological yield showed significant increases with the same species order, respectively. The families of Poaceae and Fabaceae was the best families that were used before wheat and maize in control of annual weeds associated with crops compared to other families.

This work aimed to study the allelopathic capability of some plant families that precede each of wheat or maize in the agricultural cycle, to control the annual weeds associated to wheat or maize and same time to increase their growth and productivity.

## INTRODCUTION

The environmental and health hazards from the use of herbicide have led to find the alternative methods of weed management. Among such alternatives, one is the use of allelopathic crops. They release chemicals into the soil that can contribute to weed management through suppression of weed seed germination, seedling emergence and establishment, and seedling growth (Haramoto, 2004). A successful allelochemical for weed management should inhibit germination of several weed species and not inhibit the germination of the crop (Sebile and Sengul, 2008).

Numerous crops have been investigated more or less thoroughly for allelopathic activity towards weeds or other crops. A suppressive effect on weed, possibly mediated by the release of allelochemicals has been reported for a wide range of temperate and tropic crops. These include alfalfa (*Medicago sativa*), barley (*Hordeum vulgare*), clovers (*Trifolium spp*., *Melilotus spp*.) oats (*Avena sativa*) pearl millet (*Pennisetum glaucum*), rice (*Oryza sativa*) rye (*Secale cereale*), sorghums (*Sorghum spp*.), sunflower

(*Helianthus annuus*), sweet potato (*Ipomoea batatas*) and wheat (*Triticum aestivum*) (Narwal 1996, Narwal *et al.* 1998, Weston 1996).

Allelopathy offers potential for biorational weed control through the production and release of allelochemicals from leaves, flowers, seeds, stems and roots of living or decomposing plant materials (Weston, 1996). Also, allelopathy is generally accepted as a significant ecological factor in determining the structure and composition of plant communities (Scrivanti *et al.*, 2003).

There are many families of plants had different allelopathic capability such as, Fabaceae,Asteraceae, Brassicaceae, Poaceae, Composaceae, Solenaceae, Cucurbitaceae...., but Poaceae is one of the most important and most widely used families in the world. This family is one of the reasons for the extensive research on thier allelopathic compounds. The kind and nature allelochemicals goes from phenolics to quinones with a very important diversity in this range.

The most clearly identified compounds can be divided into four groups: phenolic acids, hydroxamic acids, alkaloids, and quinones - which can be found in all parts of plants, from pollen to root exudates (Kato-Noguchi and Ino, 2001; Sanchez-Moreiras, *et al.* 2004), and confer them great advantage over other species.

Experiments were conducted in laboratory bioreactors and in field plots to test effect of certain cultivated members of the grass family (Poaceae = Gramineae), including wheat, barley, rye, oats rice, millet, corn and sorghum for soil disinfestations potential (James *et al.*, 2010).

Higher plants produce active compounds that assure the growth of seedlings by allelopathic inhibition of competitive vegetation. Allelopathic compounds are secondary plant products released into environment through volatilization, leaching, root exudation and decomposition of plant residues in soil. In many cases seeds are released and disseminated near the parent plant, and it is in this zone that allelopathic induction can be observed (Einhelling, 1995).These metabolites, such as phenolics, flavonoids, alkaloids, terpenoids isoprenoids, and cyanogenic glycosides have often attracted scientists to elucidate their structure and biological function (Rice, 1995).

Different groups of plants like; algae, lichens, crops, and annual and perennial weeds have wide known allelopathic interactions (Uddin *et al.* 2007).The release of allelochemicals, for example, hydroxamic acids from rye, maize, wheat (Niemeyer, 1988), sorgoleone from *Sorghum sp*. and phenolic acids from wheat (Wu *et al.*, 2001), and saponins from alfalfa (Miller, 1983) besides phenolic acids (Ghulam *et al.*, 2008).

All parts of Sorghum like roots, herbage and germinating seeds release materials inhibitors reducing the growth of grass and broadleaf species such as green foxtail, velvetleaf, and smooth pigweed (Panasiuk *et al.*,1986). Sorghum residues release sorgoleone, cyanogenic glycosides-dhurrin, and a number of breakdown products of phenolics that bring about weeds to suppression (Weston, 1996).

The inclusion of alfalfa in the crop rotation sequence significantly reduces the incidence of weeds in the next crops (Entz *et al.*, 1995). Blum *et al.* (1999) observed that wheat residues, both root and shoot, reduce the growth of broad-leaved weeds like ivyleaf morning glory, redroot pigweed, and prickly sida (*Sida spinosa* L.). Root residues were more effective than the shoot residues. Rye residues are an excellent example that brings about weed suppression through allelopathy (Masiunas, 1999). Barker and Bhowmik (2001) have demonstrated that residues of sunflower, and corn have a capacity to suppress weeds and enhance crop productivity of tomato. Bahraminejad *et al.* (2008) reported an antimicrobial activity of flavonoids and saponins isolated from oat shoots.

This work aimed to study the Allelopathic capability of some plant families on controlling the weeds in certain crops.

## MATERIALS AND METHODS

Two field experiments were conducted at Maryout Experimental Station, Desert Research Center during 2003-2005 winter and summer seasons, to study the allelopathic capability of some plant families on safe controlling the weeds in wheat (*Triticum aestivum* L.) and corn (*Zea mays* L.). Soil was tilled and irrigated until field cabacity, calcium super phosphate (15.5% $P_2O$) was added in rate of 200kg/fed with 20 $m^3$/fed of compost. The complete randomized blocks design in three replicates. Pot area was 12 $m^2$ (3 × 4m), including 15 rows, 20 cm apart and 4 m length in case of wheat, while it included 6 ridges at 60 cm in hills at 25 cm distance in case of maize. Soil samples were taken before planting to measure the chemical and physical soil properties as presented in tables (1 and 2).

**Table (1): Mechanical and physical properties of Maryout soil.**

| Texture | Depth (cm.) | Clay (%) | Silt (%) | Sand (%) | pH | O.M. (%) | $CaCO_3$ (%) |
|---|---|---|---|---|---|---|---|
| Sandy clay loam | 0-30 | 25.15 | 23.30 | 51.55 | 7.60 | 0.67 | 23.40 |

**Table (2): Chemical properties of Maryout soil.**

| Depth (cm.) | EC (ds/cm) | Soluble cations (meq/100 gm.) | | | | Soluble anions (meq/100 gm.) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $Na^+$ | $K^+$ | $Ca^{++}$ | $Mg^{++}$ | $Cl^-$ | $SO_4^-$ | $CO_3^-$ | $HCO_3^-$ |
| 0-30 | 1.44 | 6.15 | 0.27 | 5.00 | 3.75 | 6.38 | 3.98 | 0.00 | 4..75 |

Plant families which were used as a source of allelochemicals were sown at their sowing dates prior to each of the economical crops (wheat or maize) in the plots with lifting one plot empty as control. During Harvest, 5 cm of these plants above the soil surface were left, mixed with soil by hoeing and irrigated and left for one month as a decomposition period. Two subsequent economical crops (wheat and maize) were sown in the same plots.The summer crops prior to wheat were maize, sorghum, panicum, alfalfa, cowpea, sunflower and fallow as a control treatment. While the winter crops prior to maize were safflower, barley, canola, rye, oat, wheat and fallow as a control treatment.

Wheat (Sakha 8) was sown at a seed rate 30kg/fed on 28 November in the two seasons. During soil hoeing, calcium super phosphate (15.5% $P_2O_5$ ) was added into the soil at rate of 100 kg/fed. Nitrogen fertilization was added at rate of 90 kg/fed as ammonium nitrate (33.5% N) as broadcasting in two equal doses before the first and second irrigation. Potassium sulphate (48 % $K_2O$)was added as a rate of 50 kg $K_2O$/fed at heading stage in both seasons.

Corn crop (Pioneer-30 p9) was sown on 18 April at the rate of 15kg/fed. Nitrogen fertilization was applied in the form of ammonium nitrate (33.5% N) at the rate of 120 kg N/fed in two equal dosages i.e after thinning (two plants per hill at 21 days after sowing), and after the second irrigatioin, wlile during soil hoeing , calcium super phosphate (15.5% $P_2O_5$) was added into the soil at the rate of 100 kg/fed.

Yield of both crops were evaluated as biological and grain yield (ton/fed). These measurements had been taken from one $m^2$ sample then converted into feddan area.

In both seasons for two crops, a survey of different weed species was made by collecting all species of weeds in one $m^2$ from each plot after 45 and 90 days from sowing and estimates the fresh, dry weight (gm.) and % reduction of fresh weed for every species of weeds. Data for weeds and crops were statistically analyzed of variance (ANOVA) and least significant difference (LSD) at 5%, method was used to least the differences between the treatment means as published by Gomez and Gomez (1984).

## RESULTS AND DISCUSSON

Weed species which recorded during the season wheat crop were *Sonchus oleraceus*, *Convolvulus arvensis*, *Malva parviflora*, *Melilotus indicus*, *Cichorium endivia*, *Beta vulgaris*, *Brassica napus* and *Medicago polymorpha*, while weed species associated to maize crop were *Portulaca oleracea*, *Convolvulus arvensis*, *Setaria viridis, Dactylocteninum aegyptium, Amaranthus spp., Echinochloa colonum, Chenopodium album, Cynodon dactylon* (table, 3). The fresh and dry weights of these species were found to be reduced significantly by growing wheat next to maize, sorghum, alfalfa, sunflower, panicum , cowpea and control, respectively. Therefore, the maximum reduction of annual weeds associated to wheat was obtained by growing wheat subsequent to maize followed by sorghum (Poaceae).

Data in Table (4) indicated the effect of allelopathic activity of some crops prior to wheat on annual weeds fresh, dry weights (gm. /$m^2$), biological and grain yield (ton/fed) for wheat. Sowing wheat following to some crops (Maize, Sorghum, Panicum, Alfalfa, Cowpea and Sunflower) which belong to some plant families (Poaceae, Fabaceae and Asteraceae) resulted in significant increases in wheat growth with varying degrees and decreases in weeds fresh and dry weights compared to the control treatment. A maximum weed control of 91.5 % was observed when alfalfa pellets were applied immediately after watering the soil, but at 20 days after watering, only 55.3 % weed control was recorded (Xuan and Tsuzuki 2002).

**Table (3): Weed species present in 2003 and 2005 seasons and their families and Life cycle.**

| Annual Weed species | Families | Life cycle [a] |
|---|---|---|
| ***Sonchus oleraceus*** | Asteraceae | ABL |
| ***Convolvulus arvensis*** | Convolvulacea | PBL |
| ***Malva parviflora*** | Malvaceae | ABL |
| ***Melilotus indicus*** | Fabaceae | ABL |
| ***Cichorium endivia*** | Asteraceae | ABL |
| ***Beta vulgaris*** | Chenopodiaceae | ABL |
| ***Brassica napus*** | Brassicaceae | ABL |
| ***Medicago polymorpha*** | Fabaceae | ABL |
| ***Portulaca oleracea*** | Portulaceae | ABL |
| ***Setaria viridis*** | Poaceae | AG |
| ***Dactylocteninum aegyptium*** | Poaceae | AG |
| ***Amaranthus spp.*** | Amaranthaceae | ABL |
| ***Echinochloa colonum*** | Gramineae | AG |
| ***Chenopodium album*** | Chenopodiaceae | ABL |
| ***Cynodon dactylon*** | Poaceae | PG |

**[a]ABL, annual broad-leaved; AG, annual grass; PBL, perennial broad-leaved; PG, perennial grass.**

The allelopathic potential of oat (*Avena sativa* L., var. Argentina, Poaceae, Cyperales) was investigated under field and laboratory conditions. In field trials, oat plants provided an effective control of weeds, showing a species-specific impact: the most abundant weed species, *Picris echioides* was reduced by 94% in number of individuals. Further partitions of extract gave an active n-butanol portion composed of flavonoids and saponins. (Claudia and Marinella, 2009).

Data presented in Table (5) illustrate that compared with the control treatment, growing maize next to wheat, barley, oat, rye, canola, safflower resulted in substantial increases in maize growth and decreases weed species *(Portulaca oleracea*, *Convolvulus arvensis*, *Setaria viridis*, *Dactylocteninum aegyptius*, *Amaranthus spp.*, *Echinochloa colonum*, *Chenopodium sp.* and *Cynodon dactylon)*. The best plant that planted before maize is wheat followed by barley.

Weed control was significant influenced by sowing wheat after Maize, Sorghum and alfalfa **,** where the percentage weeds control were 88.10, 84.21and 84.12 & 80.90, 76.66 and 76.90 with *Sonchus oleraceus* and *Convolvulus arvensis*, respectively Table (6).

Many higher plants are reportedly allelopathic but only a few among them exhibit strong allelopathic activity. These include alfalfa (*Medicago sativa* L.), asparagus (*Asparagus officinalis* L.), barley (*Hordeum vulgare* L.), buckwheat (*Fagopyrum esculentum* Moench), and red clover (*Trifolium pratense* L.) (Kohli *et al.* 1998).

Sowing some plants from poaceae family i.e. maize and sorghum before the wheat crop control averaged 92.00 and 87.90 % compared to 57.70 % with cowpea which belong to fabaceae family ase after poaceae family in the percentage of weed control (84.00) with the same annual weed.

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**Table (6): Effect of some crop residues and their families prior to wheat on % reduction of fresh weed in 2003 and 2005 seasons.**

| Plant families | Crops and their families prior to wheat | | | | | |
|---|---|---|---|---|---|---|
| | Poaceae | Poaceae | Poaceae | Fabaceae | Fabaceae | Asteraceae |
| crop residues | Maize | Sorghum | Panicum | alfalfa | Cowpea | Sunflower |
| Annual weeds | Mean 45,90 days from sowing and 2003,2005 seasons | | | | | |
| *Sonchus oleraceus* | 88.10ab | 84.21ab | 61.40 a | 84.12ab | 53.30ab | 79.60 ab |
| *Convolvulus arvensis* | 80.90 b | 76.66 b | 54.20 b | 76.90bc | 45.50 c | 72.10 b |
| *Malva parviflora* | 85.60ab | 81.93ab | 60.30 a | 74.50 c | 51.60 b | 77.30 ab |
| *Melilotus indicus* | 87.00ab | 82.87ab | 59.20 ab | 82.80ab | 51.80 b | 77.90 ab |
| *Cichorium endivia* | 89.21ab | 84.50ab | 62.70 a | 85.59 a | 54.80ab | 81.21 a |
| *Beta vulgaris* | 89.01ab | 84.89ab | 62.10 a | 84.20ab | 54.29ab | 79.55 ab |
| *Brassica napus* | 90.10ab | 86.20 a | 63.60 a | 86.40 a | 55.50ab | 81.78 a |
| *Medicago polymorpha* | 92.00 a | 87.90 a | 65.00 a | 87.10 a | 57.70 a | 84.00 a |

The secondary metabolites such as 2-benzoxazolinone (BOA) and 6-methoxy-benzoxazolinone (MBOA) from wheat, rye, and corn are known to have allelopathic activity. The benzoxazinones are a class of phytoanticipins occurring in the Gramineae, Acanthaceae, Ranunculaceae, and Scrophulariaceae families (Niemeyer, 1988).

Percentage of reduction in weeds fresh and dry weights associated to maize crop are presented in table (7), which indicated that maximum reduction percent in weeds fresh and dry weights were obtained by growing maize subsequent to wheat folloed by barley and oat. Several researchers have reported that crops such as rice (*Oryza sativa* L.), barley (*Hordeum vulgare* L.), wheat (*Triticum aestivum* L.) and oats (*Avena sativa* L.) release toxic substances into the environment either through root exudation or from decaying plant materials like residues.

Further, the residues of crops like rye, sunflower, wheat, and barley, etc. could also be extremely useful in suppressing weeds (Batish *et al.*, 2001). The allelopathic effect of wheat has mainly been studied in relation to its use as green manure/straw. Wheat residues suppress weeds due to the physical effect and to the production of allelochemicals (phenolic acids and Hydroxamic acids). The release of allelochemicals from living wheat plants has also been documented (Pethó 1992).

**Table (7): Effect of some crop residues and their families prior to Maize on % reduction of fresh weed in 2003 and 2005 seasons.**

| Plant families | Crops and their families prior to Maize | | | | | |
|---|---|---|---|---|---|---|
| | Asteraceae | Poaceae | Brassicaceae | Poaceae | Poaceae | Poaceae |
| crop residues | Safflower | Barley | Canola | Rye | Oat | Wheat |
| Annual weeds | Mean 45,90 days from sowing and 2003,2005 seasons | | | | | |
| *Portulaca oleracea* | 41.30 a | 91.90 c | 57.20 f | 89.20 c | 91.10 b | 92.56 a |
| *Convolvulus arvensis* | 36.10 a | 86.59 e | 55.50 g | 83.80 e | 85.50 e | 87.41 a |
| *Setaria viridis* | 43.80 a | 92.50 b | 59.10 c | 91.10 a | 91.90 a | 93.80 a |
| *Dactylocteninum aegyptius* | 42.60 a | 92.50 b | 58.10 e | 90.10 b | 92.20 a | 93.80 a |
| *Amaranthus spp.* | 45.20 a | 93.20 a | 59.40 b | 85.20 d | 84.90 f | 89.10 a |
| *Echinochloa colonum* | 49.30 a | 91.50 c | 59.90 a | 90.10 b | 90.70 c | 93.60 a |
| *Chenopodium sp.* | 47.30 a | 89.30 d | 59.50 b | 91.10 a | 89.80 d | 94.60 a |
| *Cynodon dactylon* | 30.39 a | 79.61 f | 58.25 d | 78.19 f | 79.61 g | 82.20 a |

Crop rotation involves alternating different crops in a systematic manner on the same land and is an important strategy for weed management. Since weeds tend to thrive with crops of similar growth requirements, the cultural practices for a particular crop also benefit the establishment and growth of weeds. Continuous sole cropping on the same land results in a build up of a particular weed species that has similar growth requirements as that of crop. However, when diverse types of crops are rotated, germination and growth cycles of weeds get disrupted by variations in cultural practices (such as tillage, planting dates, and competition, etc.) associated with each crop.

Putnam and DeFrank (1983) found that residues of Sorghum reduce the number and biomass of common purslane and smooth crabgrass (*Digitaria ischaemum*) in the fields by 70 and 98%, respectively. Four- to 6-week-old Sorghum plants were observed to suppress weeds without damaging large seeded legumes and 2- to 4-week herbage was more effective than the old (6 to 8 week) herbage.

Sorghum residues release sorgoleone, cyanogenic glycosides-dhurrin, and a number of breakdown products of phenolics that bring about weed suppression (Weston, 1996).

Previous results indicated that sowing some plants from poaceae family before the wheat crop suppression of a high proportion of annual weeds, which led to lessening of competition on nutrients and thus reflected on increase in wheat crop (Table, 4). Best of the annual weeds suppression in wheat crop emerged when sowing the crop after Maize, Sorghum (poaceae family) and alfalfa (fabaceae family), and thus had clear impact on increase crop productivity, where the biological yield and grain yield (ardeb/fed) were 14.10, 27.60 & 13.50, 26.40 and 13.20 & 25.40, respectively (Table, 4).This previous result was also evident in (Table 5) for maize crop. Where better suppression of annual weeds when planting maize after wheat, barley, oat, and rye. The biological yield and grain yield (ton./fed) were 8.86, 3.51& 8.73, 3.46& 8.59, 3.41and 8.51, 3.39, respectively.

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## القابلية الأليلوباثية لبعض العائلات النباتية علي مكافحة الحشائش الآمنة في بعض المحاصيل

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**قسم وقاية النبات – مركز بحوث الصحراء – المطرية - القاهرة**

بعض العائلات النباتية (البقولية ، المركبة ، الصليبية ، النجيلية ، الباذنجانية ، القرعية) لها قدرات آليلوباثية مختلفة لانتاج وأفراز مركبات كيميائية في البيئة المحيطة لها والتي تعمل علي تثبيط نمو الحشائش الحولية في المساحة المحيطة بها. وقد تعرضت هذه الدراسة الي دراسة أستجابة كل من محصولي القمح والذرة الشامية اضافة الي الحشائش الحولية المصاحبة لهما- للمركبات الأليلوباثية المنطلقة من المحاصيل السابقة لهما أثناء الدورة الزراعية. المحاصيل الصيفية السابقة لمحصول القمح كانت (الذرة الشامية ، السورجم ، الدخن ، البرسيم الحجازي ، لوبيا العلف ، عباد الشمس). بينما كانت المحاصيل الشتوية السابقة لمحصول الذرة الشامية هي (القرطم ، الشعير ، الريب ، الراي ، الشوفان ، القمح) علي الترتيب. ولهذا الهدف أجريت تجربتان حقليتان بمحطة بحوث مريوط ، التابعة لمركز بحوث الصحراء خلال الموسمين الصيفي والشتوي من 2003-2005. وكانت أنواع الحشائش المصاحبة للقمح (جعضيض ، عليق ، خبيزة شيطاني ، سريس ، سلق ، لفت) قد أنخفضت أوزانها الغضة والجافة معنويا بزراعة القمح عقب كل من الذرة الشامية ، السورجم ، البرسيم الحجازي ، عباد الشمس ، الدخن ، لوبيا العلف علي الترتيب. وأظهر المحصول البيولوجي ومحصول الحبوب للقمح زيادة معنوية مع نفس الأنواع السابقة بعد فترة التحلل لبقايا المحصول. كذلك أنخفضت الأوزان الخضرية والجافة لأنواع الحشائش المصاحبة للذرة الشامية (نفل ، رجلة ، عليق ، صيفية ، رجل الحرباية ، عرف الديك ، أبوركبة ، زربيح ، نجيل بلدي) بزراعة الذرة الشامية كمحصول لاحق للقمح ، الشعير ، الشوفان ، الراي ، الريب ، القرطم علي الترتيب. وكانت العائلات النجيلية والبقولية من أفضل العائلات التي أستخدمت قبل محصولي القمح والذرة الشامية في مكافحة الحشائش المصاحبة لهما مقارنة بالعائلات الأخري.

وتهدف هذه الدراسة الي دراسة القدرة الآليلوباثية لبعض العائلات النباتية التي تسبق كل من القمح والذرة الشامية في الدورة الزراعية للسيطرة على الحشائش الحولية المرتبطة بهما وفي نفس الوقت لزيادة النمو والإنتاجية.

**قام بتحكيم البحث**

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**Table (4): Effect of some crop residues and their families prior to wheat on annual weeds fresh, dry weights (gm. /m$^2$), biological and grain yield (ton/fed).**

| Plant families | Crops and their families prior to wheat | | | | | | |
|---|---|---|---|---|---|---|---|
| | Poaceae | Poaceae | Poaceae | Fabaceae | Fabaceae | Asteraceae | |
| crop residues | Maize | Sorghum | Panicum | alfalfa | Cowpea | Sunflower | Control |
| Annual weeds | Mean 45,90 days from sowing and 2003,2005 seasons | | | | | | |
| | Fresh weight (gm. /m2) | | | | | | |
| *Sonchus oleraceus* | 102.42 a | 135.90 a | 332.23 a | 136.68 a | 401.95 a | 175.58 a | 860.70 a |
| *Convolvulus arvensis* | 29.70 bc | 36.30bc | 71.22cd | 35.92 b | 84.75 cd | 43.38 bc | 155.50 cd |
| *Malva parviflora* | 21.44 c | 26.90 cd | 59.11cd | 37.97 b | 72.07 cd | 33.80 cd | 148.90 cd |
| *Melilotus indicus* | 27.40 bc | 36.10 bc | 86.01c | 36.26 b | 101.61 c | 46.59 bc | 210.80 c |
| *Cichorium endivia* | 6.00 d | 8.62 e | 20.74 e | 8.01 c | 25.13 e | 10.45 e | 55.60 de |
| *Beta vulgaris* | 3.87 d | 5.32 e | 13.34 e | 5.56 c | 16.09 e | 7.20 e | 35.20 e |
| *Brassica napus* | 34.28 b | 47.79 b | 126.05 b | 47.10 b | 154.10 b | 63.10 b | 346.30 b |
| *Medicago polymorpha* | 8.99 d | 13.60 de | 39.34de | 14.50 c | 47.55 de | 17.98 de | 112.40 cde |
| | Dry weight (gm. /m2) | | | | | | |
| *Sonchus oleraceus* | 22.13 a | 29.35 a | 71.76 a | 29.53 a | 86.80 a | 37.93 a | 185.90 a |
| *Convolvulus arvensis* | 7.73 c | 9.43 c | 18.50 cd | 9.33 c | 22.00 cd | 11.26 cd | 40.39 cd |
| *Malva parviflora* | 4.83 d | 6.03 d | 13.29 de | 8.53 c | 16.20 de | 7.60 de | 33.46de |
| *Melilotus indicus* | 8.46 c | 11.13 c | 26.56 c | 11.19 c | 31.36 c | 14.38 c | 65.06 c |
| *Cichorium endivia* | 1.09 e | 1.56 e | 3.73 f | 1.43 d | 4.53 f | 1.89 f | 10.0 de |
| *Beta vulgaris* | 0.60 e | 0.80 e | 2.16 f | 0.90 d | 2.59 f | 1.16 f | 5.66 e |
| *Brassica napus* | 12.06 b | 16.83 b | 44.39 b | 16.59 b | 54.26 b | 22.23 b | 121.93 b |
| *Medicago polymorpha* | 1.96 e | 2.99 de | 8.63 ef | 30.81 a | 10.43 ef | 3.93 ef | 24.66 de |
| | yield ardeb /fed | | | | | | |
| Biological yield ardeb/fed | 14.10 a | 13.50 a | 10.10 a | 13.20 a | 8.50 a | 12.40 a | 7.70 a |
| Grain yield ardeb/fed | 27.60 b | 26.40 b | 19.50 b | 25.40 b | 16.20 b | 24.20 b | 14.90 b |

**Table (5): Effect of some crop residues and their families prior to Maize on annual weeds fresh, dry weights (gm. /m$^2$), biological and grain yield (ton/fed).**

| Plant families | Crops and their families prior to Maize | | | | | | |
|---|---|---|---|---|---|---|---|
| | Asteraceae | Poaceae | Brassicaceae | Poaceae | Poaceae | Poaceae | Control |
| crop residues | Safflower | Barley | Canola | Rye | Oat | Wheat | |
| Annual weeds | Mean 45,90 days from sowing and 2003,2005 seasons | | | | | | |
| Fresh weight (gm. /m2) | | | | | | | |
| *Portulaca oleracea* | 199.87 a | 27.58 a | 145.73 a | 36.77 b | 30.30 b | 25.33 b | 340.50 a |
| *Convolvulus arvensis* | 32.27 d | 6.77 d | 22.47 d | 8.18 e | 7.32 d | 6.36 e | 50.50 c |
| *Setaria viridis* | 197.32 a | 26.33 ab | 143.6 ab | 31.25 c | 28.44 b | 21.77 bc | 351.10 a |
| *Dactylocteninum aegyptius* | 121.00 c | 15.81 c | 88.33 c | 20.87 d | 16.44 c | 13.07 d | 210.80 b |
| *Amaranthus spp.* | 189.33 a | 23.49 b | 140.27 ab | 51.13 a | 52.17 a | 37.66 a | 345.50 a |
| *Echinochloa colonum* | 157.37 b | 26.38 ab | 124.47 b | 30.73 c | 28.87 b | 19.87 c | 310.40 a |
| *Chenopodium sp.* | 127.80 c | 25.95 ab | 98.21 c | 21.58 d | 24.74 b | 13.10 d | 242.50 b |
| *Cynodon dactylon* | 21.51 d | 6.30 d | 12.90 d | 6.74 e | 6.30 d | 5.50 e | 30.90 c |
| Dry weight (gm. /m2) | | | | | | | |
| *Portulaca oleracea* | 26.51 d | 3.66 a | 19.33 d | 4.89 c | 4.03 c | 3.36 c | 45.16 e |
| *Convolvulus arvensis* | 8.39 e | 1.76 b | 2.93 e | 2.13 d | 1.90 e | 1.66 d | 13.13 f |
| *Setaria viridis* | 52.63 b | 7.03 ab | 38.29 b | 8.33 b | 7.59 b | 5.80 b | 93.63 b |
| *Dactylocteninum aegyptius* | 32.79 cd | 4.26 ab | 23.93 d | 5.66 c | 4.46 c | 3.56 c | 57.13 de |
| *Amaranthus spp.* | 59.90 a | 7.43 ab | 44.39 a | 16.19 a | 14.17 a | 11.93 a | 109.36 a |
| *Echinochloa colonum* | 37.73 c | 6.33 ab | 29.86 c | 7.36 b | 6.90 b | 4.76 b | 74.43 c |
| *Chenopodium sp.* | 31.86 cd | 6.46 ab | 24.49 d | 5.39 c | 6.19 b | 3.26 c | 60.46 d |
| *Cynodon dactylon* | 10.00 e | 2.93 a | 1.73 e | 3.13 d | 2.93 de | 2.56 cd | 14.36 f |
| yield ton/fed | | | | | | | |
| Biological yield ton/fed | 4.09 a | 8.73 a | 5.69 a | 8.51 a | 8.59 a | 8.86 a | 3.11a |
| Grain yield ton/fed | 1.63 b | 3.46 b | 2.26 b | 3.39 b | 3.41 b | 3.51 b | 1.36 b |