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The effects of walnut and pine leaves on bread wheat growth and frequence of common weed species in the East-Mediterranean region

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Abstract: *A field experiment was carried out to determine the effects of walnut (Juglans regia L.) and pine (Pinus sp.) leaves on bread wheat (Triticum aestivum L.) growth and weed control, during 2001-02 and 2002-03 growing seasons in East Mediterranean region of Turkey. In this research, the treatments were: applications of ground walnut leaves (GWL) and ground pine leaves (GPL) at 19 g/m² dose at Zadoks-11, applications of 200, 400 and 800 cc/m² of walnut leaves extract (WLE2, WLE4 and WLE8 respectively), pine leaves extract (PLE2, PLE4 and PLE8 respectively), mixture extract of 200 cc walnut and 200cc pine (ME), herbicide application (HA) at 8 g/m² dose at Zadoks-21, and control (C) without any treatment. The results have indicated that the effects of treatments were significant for grain yield (GY), plant height (PH), flag leaf length (FLL), weed number per square meter (WN), but non significant for grain number per head (GN), grain weight per head (GW), 1000 grain weight (1000 GW), flag leaf width (FLW), head number per square meter (HN), vegetative period (VP), grain filling period (GFP) and days to maturity (DM).*

Key words: *Allelopathy, Walnut, Pine, Extracts, Wheat, Yield, Yield components, Weed number.*

Introduction

Weed management has been a worldwide problem and three million tonnes of herbicides per year are used in most agricultural systems (Stephenson, 2000). Since there have been increasing herbicide resistance in weeds and adverse environmental effects, biorational alternatives are gaining increased attention for weed control. Allelopathy offers 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).

Research on allelopathy has been undertaken to select allelopathic germplasms and to identify allelochemicals in the field and laboratory experiments. Several accessions of cucumber, *Cucumis sativus* L., (Putnam and Duke, 1974), oat, *Avena sativa* L., (Fay and Duke, 1977), rice, *Oryza sativa* L., (Dilday *et al.,* 1994; Olofsdotter and Navarez, 1996; Ebana *et al*., 2001) were screened for allelopathic effects. Accesions with allelopathic effect have been found in crops such as beet (*Beta vulgaris* L.), lupine (*Lupinus lutens* L.), maize (*Zea mays* L.), wheat (*Triticum aestivum* L.), oat (*Avena* sp.), pea (*Pisum sativum* L.), barley (*Hordeum vulgare* L.), rye (*Secale cereale* L.) and cucumber (*Cucumis sativus*) (Rice, 1984).

Chemicals with allelopathic potential are present virtually in all plants and in most tissues, including leaves, stems, flowers, roots, seeds and buds (Weston, 1996). Allelopathy can be used in weed management by applying residues and straw as mulches or growing an allelopathic variety in a rotational sequence that allows residues to remain in the field (Rice, 1995). Chung *et al*. (2003) indicated that different parts of rice parts may be a source of natural herbicides and that it is necessary to develop acceptable selection standards. Extracts from the leaves of rice seedlings at the six-leaf age inhibited the growth of ducksalad (*Heteranthera limosa* Willd.) and lettuce (*Lactuca sativa* L.) (Ebana *et al*., 2001). The allelopathic potential of alfalfa (*Medicago sativa* L.) as natural herbicide was evaluated (Dornbos *et al*., 1990; Wyman-Sympson *et al*., 1991) and alfalfa residue has a contrasting effect on weed growth and development due to water soluble allelochemicals present in the residue (Chung and Miller, 1995). Both young and mature growth stages of chickweed (*Stelleria media* L.) can contribute water-soluble phenolics to the soil and chickweed could be allelopathic to a crop of the current season under natural conditions (Inderjit and Dakshini, 1998). Diluted extracts of common oleander (*Nerium oleander* L.) and chinaberry (*Melia azedarach* L.) inhibited seed germination of weeds (Uygur and Iskenderoglu, 1997). Bermudagrass (*Cynodon dactylon* L.) and johnsongrass (*Sorghum halepense* L.) inhibited cotton (*Gossipium hirsutum* L.) and corn (*Zea mays* L.) growth (Vasilakoglou *et al*., 2005). This field experiment was designed to determine the detrimental or beneficial effects of ground and extracts of walnut and pine leaves on bread wheat yield, yield components and weed density and to determine their potential using in bread wheat production.

Materials and Methods

General procedure: This research was carried out in the 2001-02 and 2002-03 growing seasons in Kahramanmaras province located in East-Mediterranean region of Turkey. The soil samples from 0 to 30 cm depth of experimental area were taken and analyzed. The experimental soil had loamy texture, pH 7.43, 23.5 % $CaCO_3$ content, 42.5 kg ha^{-1} available P_2O_5, 801.9 kg ha^{-1} available K_2O and 1.2 % organic matter content.

The experimental design was randomized complete block design with four replications. The land was plowed in the fall after harvest of cotton crop and was cultivated with a harrow

Table – 1: Average results of vegetative period (VP), days to maturity (DM), grain filling period (GFP), plant height (PH), flag leaf width (FLW) and flag leaf length (FLL) for different treatments.

	Growth stages (day)			Plant height and flag leaf (cm)		
	VP	**DM**	**GFP**	**PH**	**FLW**	**FLL**
	ns	ns	ns	**	ns	**
GWL	173.1	203.3	30.6	98.7 a	1.50	21.2 a
GPL	172.6	204.0	31.8	97.8 ab	1.45	19.5 c
WLE2	173.0	203.8	31.3	96.0 abc	1.47	20.9 ab
WLE4	173.2	203.7	31.0	95.3 bcd	1.45	21.3 a
WLE8	172.7	203.6	31.3	93.8 cd	1.47	20.1 abc
PLE2	173.0	204.7	32.5	97.0 ab	1.61	20.8 ab
PLE4	173.5	204.0	31.2	93.3 d	1.45	21.0 a
PLE8	173.3	203.8	31.1	99.6 a	1.54	20.0 abc
ME	172.5	205.0	32.7	97.0 ab	1.52	21.1 a
HA	173.1	204.2	31.6	94.7 bcd	1.44	19.6 bc
C	172.6	203.2	31.1	96.9 ab	1.44	19.7 bc

** Significant at $p < 0.01$; ns, not significant

disk to prepare the soil for planting. The planting dates were 17 November 2001 and 05 November 2002. Seeding rate of bread wheat variety Bal-Atilla was 550 seeds m^{-2} at 1.2 m by 8.3 m plots with 8 plant rows. Fertilizer applications were 80 kg N ha^{-1} and 80 kg P_2O_5 ha^{-1} at planting and 100 kg N ha^{-1} additional nitrogen at the tillering stage.

Preparation of ground leaves and water extracts: The leaves of pine and walnut were collected in fall and dried for 48 hr at room temperature (around 25°C). Air-dried leaves of plants were grounded in a mill through a 40-mesh screen (Vasilakoglou *et al*., 2005). Water extracts (w/v) were prepared by extracting 5 g ground samples with 100 ml of distilled water and stirred for 24 hr at room temperature. The solutions were filtered, centrifuged at speed of 3000 rpm for 4 hr and stored at less than 5ºC (Chung *et al*., 2003).

Treatments: In the present study, there were 11 treatments as follows;

GWL: applications of ground walnut leaves at the 19 g m^{-2} dose at Zadoks-11,

GPL: application of ground pine leaves at the 19 g m^{-2} dose at Zadoks-11,

WLE2: application of walnut leaves extract at the 200 cc m^{-2} dose at Zadoks-21,

WLE4: application of walnut leaves extract at the 400 cc m^{-2} dose at Zadoks-21,

WLE8: application of walnut leaves extract at the 800 cc m^{-2} dose at Zadoks-21,

PLE2: application of pine leaves extract at the 200 cc m^{-2} dose at Zadoks-21,

PLE4: application of pine leaves extract at the 400 cc m^{-2} dose at Zadoks-21,

PLE8: application of pine leaves extract at the 800 cc m^{-2} dose at Zadoks-21,

ME: application of mixture of 200 cc walnut and 200 cc pine extracts at Zadoks-21,

HA: application of 8 mg m^{-2} of 75% tribenuron-methyl at Zadoks-21,

C: control without any treatment.

Statistical analysis: Grain yield (GY), grain number per head (GN), grain weight per head (GW), 1000 grain weight (1000 GW), plant height (PH), flag leaf length (FLL), flag leaf width (FLW), head number per square meter (HN), vegetative period (VP), grain filling period (GFP), days to maturity (DM), weed number per square meter (WN) were evaluated for different treatments. The data were analyzed using statistical software of SAS (SAS Inst., 1999) and Duncan groups were used for ranking of means.

Results and Discussion

Growth stages: Effects of applications on VP, DM and GFP were not significant. The effect varied between 172.5 and 173.5 days for VP, 203.2 and 205.0 days for DM, 30.6 and 32.7 days for GFP (Table 1). There were no beneficial or detrimental effects of treatments on growth stages.

Plant height (PH) and flag leaf (FL): Effect of applications on pH was significant ($p<0.01$). The shortest PH (93.3 cm) was obtained from PLE2 application, while the longest PH (99.6 cm) has from PLE8 application. Although there were significant effects of applications, there were no constant effects of applications in detrimental or beneficial ways and means were generally irregularly grouped. But there was a general tendency that ground leaves and lower doses of extracts generally resulted in higher PH values.

Effects of treatments on FLL were significant ($p<0.01$), while insignificant on FLW (Table 1). The values of FLW ranged between 1.44 and 1.61 cm. The longest FLL (21.3 cm) was obtained from WLE 2 and the shortest FLL (19.5 cm) from GPL application. The ground and extract applications, except GPL application, generally increased FLL, compared to HA and C treatments.

Table – 2: Average results of head number per square meter (HN), grain number per head (GN), grain weight per head (GW), 1000 grain weight (1000 GW), grain yield (GY) and weed number per square meter (WN) for different treatments.

	Yield components				**GY(kg ha $^{-1}$)**	**WN**
	HN (head m^{-2})	**GN(grain per head)**	**GW (g)**	**1000-GW (g)**		
	ns	*	ns	ns	**	*
GWL	657.1	32.3 abc	1.07	29.7	5236 cd	24.7 ab
GPL	643.6	32.6 abc	1.08	29.9	5783 ab	26.4 ab
WLE2	616.0	33.0 abc	1.09	30.3	5784 ab	29.1 a
WLE4	654.3	27.6 c	0.90	28.9	5483 bc	22.6 ab
WLE8	606.6	36.0 a	1.16	28.7	4969 d	33.1 a
PLE2	685.0	32.1 abc	1.21	32.4	5618 bc	30.4 a
PLE4	657.5	32.4 abc	1.13	30.2	5731 abc	24.8 ab
PLE8	666.8	35.5 ab	1.14	30.5	5259 bcd	28.7 ab
ME	653.8	35.5 ab	1.21	31.0	6143 a	30.8 a
HA	622.1	32.1 abc	1.14	31.5	5754 abc	16.4 b
C	626.0	29.4 bc	0.90	32.4	5799 ab	31.0 a

**Significant at p<0.01and * at p<0.05; ns, not significant

Yield components: The head number per square meter was not significantly affected by applications and HN values ranged between 606.6 and 685.0 heads m^{-2} (Table 2).

According to variance analysis results, effects of treatments on GN were not significant, but there were different Duncan groups at the 0.05 probability level for GN (Table 2). The lowest GN (29.4) was obtained from C, while the highest (36.0) from WLE 8 application. The grain number per head was 32.1 for HA. As it can be seen from results, there was a general increase in ground and extract applications of leaves and these applications, except WLE 2, resulted in increased GN in comparison with C, but similar with HA.

Effects of applications on GW and 1000 GW were not significant. The values ranged between 0.90 and 1.21 g for GW and 28.7 and 32.4 g for 1000 GW. It could not be ascertained whether the effects were detrimental or beneficial on these traits.

Grain yield: The treatments were significantly effected on GY (p<0.01) and the highest GY (6143 kg ha^{-1}) was obtained from ME treatment (Fig. 1). But GY obtained from ME application was not significantly higher than those obtained from HA and C treatments and they were in the same group. The WLE 8 application resulted in the lowest grain yield (4969 kg ha^{-1}) and the differences between WLE8 and PLE8 applications were not significant. These results have indicated that higher amounts of extracts of pine and walnut leaves may decrease wheat grain yield, while lower amounts may contribute to GY. In addition it may be possible to obtain better results when extracts are mixed. On the other hand, GWL had detrimental effect on GY like higher amounts of extracts, while there were no effects of GPL.

Different results related to the allelopathic effects on growth and yield of crops have been reported in the literature. Malik and Shah (1995) indicated that the growth of pea was significantly reduced due to allelopathic effects of *Eucalyptus* species, while there was no significant effect on various growth parameters including yield of bean. Mixtures of allelochemicals and other organic compounds can cause allepopathic inhibitory effects (Blum, 1996). Cheema (1998) reported the important allelopathic effect of sorghum for reducing dry weight of important weeds and increasing wheat yield by 10-20 %. Chickweed has potential to contribute water-soluble phenolics to the soils that may have potential to affect wheat growth (Inderjit and Dakshini, 1998). Extracts from the leaves of rice seedlings at the six-leaf age inhibited the growth of ducksalad and lettuce (Ebana *et al*., 2001). Vasilikoglou *et al*., (2005) indicated that yield and growth of cotton and corn were reduced by the release in potential allelopathic substances release from Bermudagrass and Johnsongrass, and cotton growth was inhibited more than corn.

Weed number (WN): According to variance analysis result, there was no significant effect of treatments on WN. But different groups of means were obtained when Duncan test was applied (p<0.05). Duncan test showed that HA gave the best result for weed control and WN for HA was 16.4 (Fig. 2). But ground and extract applications could not decrease WN in comparison with C. Although some treatments had same effect with HA, it would be difficult to conclude that there were constant positive effects of ground and extracts for weed control in the field condition.

Because allelopathic effects depend on several factors such as decaying, retention, transformation concentration and soil conditions. Processes such as retention, transformation and transport may affect the active concentration of allelochemicals and hence allelopathic effects in the soil (Cheng, 1995). The allelopathic potential of alfalfa as natural herbicide was evaluated (Dornbos *et al*., 1990; Wyman-Sympson *et al*., 1991) and alfalfa residue has a contrasting effect on weed growth and development due to water soluble allelochemicals present in the residue (Chung and Miller, 1995). Diluted extracts of common oleander and chinaberry inhibited

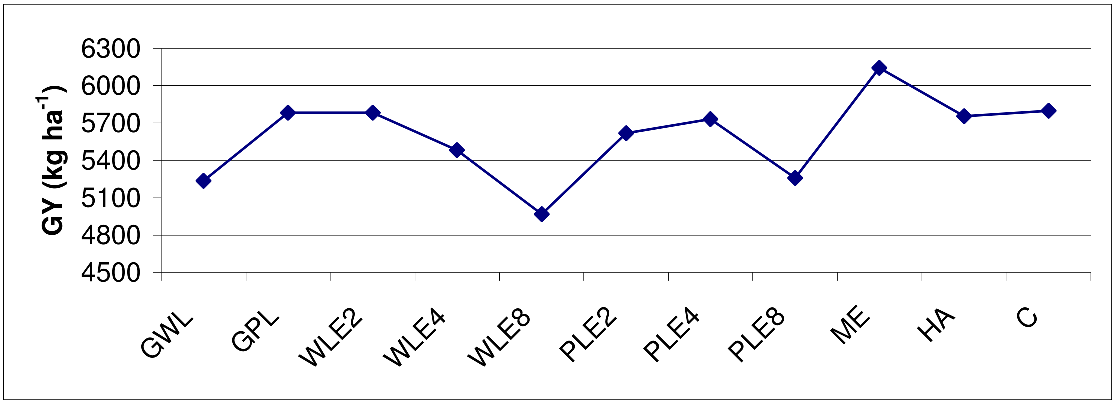

Fig. 1: Grain yield according to the treatments.

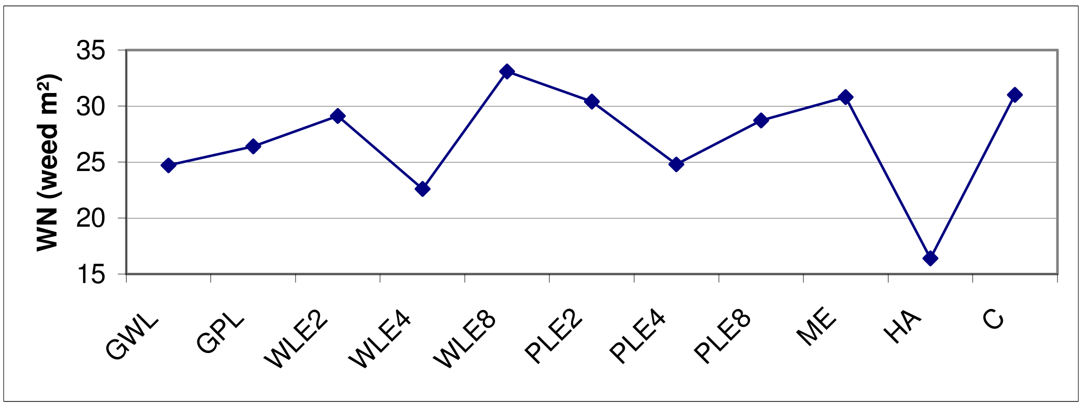

Fig. 2: Weed number according to the treatments.

the seed germination of weeds (Uygur and Iskenderoglu, 1997). Cover crop residues may selectively provide weed suppression through their physical presence on the soil surface and by release of allelochemicals or microbially altered allelochemics (Weston, 1996). Cheema *et al*. (1997) reported decreasing effect of water extracts of sorghum and sunflower plants on weed growth. Chung *et al*., (2003) indicated that allelopathic compounds present in rice hulls, leaves and straws may serve as a potential natural herbicide.

This field study suggests that higher amounts of extracts of pine and walnut leaves may decrease wheat grain yield, while lower amounts may contribute to grain yield. In addition, it may be possible to obtain higher grain yield when extracts are mixed. On the other hand, ground leaves of walnut may have detrimental effect on grain yield like higher amounts of extracts. But, we could not find the constant positive effects of ground and extracts of walnut and pine leaves for weed control under field conditions. This study shows that new researches on stimulatory or inhibitory potentials of walnut and pine leaves may provide useful information for wheat production and weed control and field tests for detrimental and beneficial effects need several years and locations of replication.

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