J. Agric. Sci. Mansoura Univ., 27(5): 3495 - 3509, 2002

DETERMINATION OF TRALKOXYDIM AND TRIBENURON-METHYL RESIDUES IN WHEAT PLANT, SOIL AND ITS EFFECT ON APHIDS INFESTATION AND ON FRESH YIELD.

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ABSTRACT

The field experiment was conducted at Fayoum Governorate to determine the effect of Tralkoxydim 10% EC and Tribenuron-methyl 75% residues in two wheat varieties (Cids-7 and Giza-164) against infestation of aphids; *Schizaphis graminum* (Rondani) and *Rhopalosiphum padi* (L.) during 1998–1999 and 1999–2000 seasons. Results indicated that the two studied varieties were highly susceptible to the infestation with aphid *R. padi* and less susceptible to *S. graminum*. The Giza 164 variety was less susceptible to *R. padi* (34.95, 30.66 and 16.71, 12.36 individual/plant) than Cids 7 variety (94.05, 86.56 and 39.81, 32.36 individual/plant) by contrast, the former variety was more less susceptible to *S. graminum* than the second one (1.21, 0.83; 3.48, 2.66 individual/plant and 0.98, 0.58; 2.25, 1.71 individual/plant), with untreated and treated during two successive seasons respectively.

The times for 50% loss of initial Granstare in soil were 50.97 and 49.33 days for Giza 164 and Cids 7, respectively. The loss of initial Granstare concentration in the leaves of Giza 164 and Cids 7 were (4.52 & 5.19 ppm). The Granstare residue became undetected in grains of the two varieties after 170 days.

At the end of experiment, about 99.64 and 99.66% loss of initial Grasep in the soil in both two varieties. After 95 days, only 0.91 and 1.12 ppm of Grasep reached to the grains of Giza 164 and Cids 7 varieties, respectively. At the end of experiment (155 days) there were no Grasep residues in the grains of the two varieties. These results indicated that the effect of Granstare and Grasep herbicides on growth was greater in Cids 7 than in Giza 164 varieties and Granstare + Grasep used to control weeds and give a good yield comparing with untreated wheat plants.

INTRODUCTION

Wheat is the staple food crops for man both in Egypt and the world as well. The cereal aphids come as major key pest for this crop. Under Egyptian conditions, Elliot *et al*. (1990), De Barro (1992), Al-Ansary (1993), Archer and Bynum (1993), Beregovoy and Peters (1994), Hasken and Poehlin (1995), Havlickova (1997) recorded *Schizaphis graminum* (Rondani) and *Rhopalosiphum padi* (L.) infested wheat in Egypt and the world. The winter cereals especially damage by broad-leaved weeds.

Granstare (75%) dry flowable (DF) herbicide was used to protect winter cereals especially winter wheat from broad-leaved weeds, its mod of action was inhibited the synthetic of branched chain amino acid.

Grasep (10% EC) was herbicide observed by foliage, translocated in the phloem to the growing points where it inhibited new growth. Used to control *Alopecurus myosuroides, Apera spica-venti, Avena* spp., *Lolium rigidum, Setaria*

viridis and *Phalaris* spp. in wheat plant. Its mode of action is used as inhibitor of cell division.

Using Grasep increased the farmer's income by 300 L.E/fed. because the weeds caused depletion of yield crops by 30%.

The aim of this investigation was to study the population of aphids for treated and untreated fields by the two herbicides as well as the behavior and degradation of these herbicides in soil to determine if persistent these herbicides soil residues could hinder the normal flowing crop, and in plant parts after spraying them in interval times of experiment. Also, the total fresh yields (ardab/fed.) were determined for treated and untreated two varieties of wheat grains under field conditions.

Some experiments had been reported to evaluate some herbicide as tribenuron methyl and its persistence in the soil (Nilsson, 1991) to determine if persistent those herbicides soil residues could hinder the normal following crop or not. Srivastava *et al*. (1995) studied the persistence of tralkoxydim in wheat crop and in soil under field conditions.

MATERIALS AND METHODS

Sample and herbicides:

Two varieties of Egyptian wheat grains used in this study (Giza 164 and Cids 7) were supplied by the Wheat Research Section, Agric. Res. Center, Giza, Egypt. Granstare (Tribenuron-methyl 75% DF) systemic herbicide 2-[Lmethoxy-6-methyl-1, 3, 5-triazin-2-yl (methyl) carbamoyl] benzoic acid was used as the recommended rate by the Ministry of Agriculture, Egypt (Pest control programme of crops field, 1993 was 8 g/fed.). Grasep 10% EC: 2-[1-(ethoxyimino propyl)–3– hydroxy–S–methyl cyclohex–2–enone) it is recommended rate was 1 L/fed. Field experiment was carried out at Fayoum Governorate on November 1998 – 1999 and 1999 – 2000 seasons to evaluate persistence, translocation of used systemic herbicide in plant parts and in soil, to investigate its efficiency against weeds and determine the total yields for treated and untreated area. About ¼ fed. was used and divided into two plots, four replicates for untreated two varieties and four replicates for treated two varieties with two herbicides. After planting by 10 days Granstare was sprayed at recommended rate (8 g/fed.). Aphid counts were undertaken, weekly soon after seedlings emergence by visual counting of aphid from 25 tillers taken randomly out of 25 plants from each replicate; and from each treatment plant parts and soil samples were taken after zero time (one hour), 15, 30, 50, 80, 110, 140 and 170 days after spraying. Then Grasep was sprayed after 25 days of planting (zero time), 15, 35, 65, 95, 125 and 155 days after spraying. These samples were subjected to residues analysis of used herbicides in soil leaves and grains. The fresh yields crops (ardab/fed.) and growth characters of two wheat plant varieties at the end of experiment in treated and untreated area.

Residues determination:

A- Extraction:

Granstare and Grasep were extracted from leaves, grains and soil (50 g of each sample) according to the method of Klaus *et al*. (1974). All samples were cleaned up using sap-pale cartridge (C_{18}) according to the method of Ikebuchic *et al*. (1985).

B- Determination:

The residues of two herbicides were determined using Beckman HPLC instrument fitted with variable wave length detector (119), C_{18} stainless steel column (10 x 250 mm), dual pump for delivering solvent (110) and mobile phase water/methanol (10/90) for Granstare and (20/90) for Grasep, flow rate (1 ml/min.). The retention time (2.07 min.) for Granstare and (2.85 min.) for Grasep. The detection limit was 0.03 and 0.05 for Granstare and Grasep, respectively. Data were statistically analyzed according to Snedecor and Cochran (1967) and were subjected to the simple correlation and regression analysis.

RESULTS AND DISCUSSIONS

Data presented in Table (1) and Fig. (1) show clearly that the two tested wheat varieties either treated or untreated were attacked by aphids *Schizaphis graminum* (Rondani) and *Rhopalosiphum padi* (L.) This indicated also by Tantawi *et al*. (1986) recorded two species of aphids infesting wheat plants (*R. padi* and *S. graminum*). Wheat weeds treatments with Granstare and Grasep herbicides showed that, Giza-164 variety was the least susceptible one to *R. padi* aphids infestation (16.71 and 12.36 individual/plant), while the untreated Giza-164 variety showed intermediate susceptibility (34.95 and 30.66), in addition, the untreated Cids-7 wheat variety tend to be highest susceptible to *R. padi* aphid investation, (94.05 and 86.56 indiv./plant), in contrast the treated plots showed intermediate susceptibility to the same aphid investation (39.81 and 3.36 indiv./plant) during the two successive seasons, 1998/1999 and 1999/2000.

On the other side Cids 7 and Giwa 164 wheat varieties apperade to be less susceptible to *S. graminum* aphid investation in both case of treated and untreated plots [(5.9 and 3.5) and (7.3 and 5.0)] and [(13.5 and 10.3) and (20.9 and 16.0) indiv./plant] during the two tested seasons. Van Guden (1972) came to the conclusion that cereal aphids were more sensitive to the applied insecticides.

Granstare (Tribenuron-methyl) is active against broad-leaved weeds which competed wheat plant in its nutrition, it is developed in mixture with cereal herbicide (Grasep) to ensure effective control of competitive weeds associated with the long growing cycle of the winter cereal crop. Nilsson (1991) showed that the tribenuron-methyl had the shortest persistence and rarely lasted as residues in soil for > 2 months.

Data in Table (2) and Figs. (2 and 3) showed the behavior of Granstare in soil, leaves and grains of wheat plant.

table1

fig1

table2

fig2,3

The concentration of Granstare in soil after application (zero time) was (12.24, 15.27 ppm) for Giza-164 and Cids-7, respectively. The time for 50% loss of initial Granstare in soil were (50.97 and 49.33 days) for Giza-164 ad Cids-7, respectively and reached to about (0.25 and 0.29 ppm) and (97.96 and 98.1% loss) after 170 days of application for the two varieties. There was no obviously different between the rate of degradation constant of Granstare in the two varieties, and its degradation should correspond to greater microbial and enzymatic soil activities. These are in agreement with those of Berger *et al*. (1998) who reported that the natural production of citric acid by the fungus, caused decreasing in pH followed by chemical hydrolysis of herbicides. About (8.7, 10.85 ppm) were found in leaves of Giza-164 and Cids-7 wheat varieties, respectively, at zero-time (10 days after planting), then after 30 days the concentration of Granstare in leaves were (4.52, 5.19 ppm) or (48.05, 52.17% loss) of the initial Granstare concentration in the leaves of Giza-164 and Cids-7, respectively, and became (93.22%, 93.18% loss) after 80 days in the two varieties. Only (0.19, 0.21 ppm) of Granstare were detected after 110 days of application in grains of Giza-164 and Cids-7 wheat varieties, respectively. So, about (97.82, 98.06% loss) of the initial Granstare concentration in the leaves of the two varieties by degradation during 110 days. After 170 days, the Granstare residue became undetected in grains of the two varieties.

These results were in agreement with those of Jean Rouchaud *et al*. (1991) as they reported diflufenican herbicide and its metabolites residue in the grain of wheat and they found that none of these compounds was ever detected in the flour after harvest.

Grasep (tralkoxydim) used as inhibitor for acetyl coenzyme-A carboxylase which catalyses the first committed step in fatty acid biosynthesis (Secor and Cseke, 1988).

Table (3) and Figs. (4 and 5) showed the residual behavior of Grasep in soil, leaves and grains of wheat plant under field conditions. At zero-time (25 days after planting), the concentration of Grasep in the soil were (22.3, 26.68 ppm) in Giza-164 and Cids-7, respectively, after 65 days about (46.14%, 51.57%) loss of the initial Grasep concentration in the soil of Giza-164 and Cids-7, respectively, and at the end of experiment about (99.64% and 99.66%) loss of initial Grasep in the soil in both two varieties. The time for 50% loss of initial Grasep in soil was shorter in Cids-7 than in Giza-164 varieties (45.63, 49.66 days). The persistence of tralkoxydim in the grains became detectable after 125 days of application. Srivastava *et al*. (1995) studied the dissipation of tralkoxydim herbicide in wheat crop soil under sub-tropical conditions. On the other hand the concentration of Grasep at zero-time in leaves were (12.06, 14.59 ppm) in Giza-164 and Cids-7, respectively, after 35 days of application Grasep residue was (52.3%) loss of initial Grasep in the leaves of Giza-164, but after 35 days Grasep residue was (61.41%) loss of initial concentration in the leaves of Cids-7 variety. And after 65 days, the Grasep residue became (1.5, 2.1 ppm) about (88.1, 85.6%) loss of initial. Grasep in the leaves of Giza-164 and Cids-7, respectively.

table3

fig4,5

The degradation coefficients of Grasep in leaves were (2.42×10^{-2}, 2.58×10^{-2} ppm. d^{-1}) and half-lives were (28.66, 26.86 days) for Giza-164 and Cids-7 varieties, respectively, under field conditions. So, Grasep was useful to control weeds without affect on wheat plants. Marshall *et al*. (1996) studied that the wheat was identified by its rapid uptake and subsequent degradation of ^{14}C-tralkoxydim (within 6 h.) in the treated leaves. After 95 day only (0.91 and 1.12 ppm) of Grasep reached to the grains of Giza-164 and Cids-7 varieties, respectively. On the other hand, about 92% loss of initial Grasep in leaves in both two varieties by degradation. At the end of experiment (155 days), there were no Grasep residue in the grains of the two varieties.

Table (4) and Fig. (6) showed the effect of Grasep treatment on growth characters and fresh yield crop (ardab/fed.) of the two varieties of wheat plant after 180 days of planting. The spike length reduced from (8.125, 8.150 cm) and (8.265, 8.60 cm) of untreated wheat plant to (5.25, 5.75 cm) and (4.63, 4.80 cm) of treated ones or about (64.6, 70.5%) and (53.6, 55.8%), relative to control, of Giza-164 and Cids-7, respectively. Also, number of seeds/spike reduced from (45.46) and (44, 43) to (27, 29) and (17, 19) or (59.4, 63.0%) and (38.6, 49.2%) or (59.4, 63.0%) and (38.6, 44.2%) relative to control, and number of tillers/m^2 reduced from (1533, 1569 and 1083, 10921) to (516, 523 and 450, 475) about (33.7, 33.3% and 41.67, 43.5%) relative to control of Giza-164 and Cids-7, respectively, but the fresh yield crops increased from (9.5, 9.8 and 10.5, 10.6) to (12.5, 12.5 and 14.0, 14.5 ardab/fed.) about (131.58, 129.59% and 133.33, 134.43%) relative to control for Giza-164 and Cids-7 during two successive seasons; 1988/1999 and 1999/2000, respectively.

These results indicated that the effect of Grenstare and Grasp treatment for control wheat weeds increased yield production, which gave (12.5 and 14.0 ardab/fed.) and (12.7 and 14.25 ardab/fed.) in compared with untreated check (9.5 and 10.5 ardab/fed.) and (9.8 and 10.1 ardab/fed.) for Giza-164 and Cids-7 varieties during the two tested seasons respectively.

Kumar (1998) reported that all weed control treatment caused marked improvements in the shoot dry matter production and nutrient uptake of wheat crop compared with the weedy control treatment.

From the previous results can deduced that Granstare and Grasep herbicide degraded rapidly during planting of wheat in soil, leaves and grains. They were active herbicide against broad-leaved weeds and other weeds in wheat plants. Therefore, the Granstare and Grasep herbicides can be recommended for using at rate of application as spraying for wheat plant without any affecting on the yield or on soil.

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تقدير متبقيات ترالك أوكسيدم (جراسب) وتراى بنيورون (جرانستار) فى نباتات القمح وفى التربة وتأثيرهما على الإصابة بالمن وعلى كمية المحصول٠

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تم زراعة صنفين من القمح (جيزة ١٦٤، سدس ٧) فى محافظة الفيوم، مركز الفيوم عامى ١٩٩٨/١٩٩٩ و ١٩٩٩/٢٠٠٠ وتم رش النباتات بمبيدين من مبيدات الحشائش هما جرانستار وجراسب على النحو التالى:

- استخدم جرانستار ٧٥% مسحوق قابل للذوبان لمقاومة الحشائش عريضة الأوراق التى تنافس نباتات القمح فى غذائها وبالتالى تضعفها بعد تمام الإنبات (بعد حوالى ١٠ أيام من الزراعة) بمعدل ٨ جرام/فدان (الجرعة الموصى بها) وأخذت عينات من الأوراق والتربة تم فيها تقدير المتبقيات على الفترات الآتية: صفر (١٠ يوم من الزراعة)، ١٥، ٣٠، ٥٠، ٨٠، ١١٠، ١٤٠، ١٧٠ يوم بعد الرش٠
- تم رش صنفى القمح بعد ذلك بمبيد جراسب ١٠% (قابل للاستحلاب) بمعدل ١ لتر/للفدان (يستعمل هذا المبيد لمقاومة الزميرة والحشائش النجيلية) بعد حوالى ٢٥ يوم من الزراعة (من ٤ ـ ٥ ورقات)، وأخذت عينات من الأوراق والتربة، وتم تقدير المتبقيات على الفترات الآتية: صفر (٢٥ يوم من الزراعة)، ١٥، ٣٥، ٦٥، ٩٥، ١٢٥، ١٥٥ يوم من الرش٠
- تركت قطعة مزروعة بنفس صنفى القمح بدون معاملة بالمبيدات السابقة للمقارنة٠
- تم فحص كل المعاملات لصنفى القمح المعاملة وغير المعاملة للإصابة بحشرتى المن *Schizaphis graminum* (Rondani), *Rhopalosiphum padi* (L.)٠

ولقد دلت النتائج المتحصل عليها على:-

1- وجد أن صنف جيزة ١٦٤ أقل حساسية للإصابة بالمن *R. padi* مع المعاملة بمبيدات الحشائش جرانستار وجراسب حيث كان متوسط الإصابة ٧١ر١٦، ٣٦ر١٢ فرد/نبات وبدون معاملة ٩٥ر٣٤، ٦٦ر٣٠ فرد/نبات خلال عامى ١٩٩٨/١٩٩٩ و ١٩٩٩/٢٠٠٠ على التوالى٠

2- أيضا صنف سدس ٧ أقل حساسية للإصابة بالمن *R. padi* مع المعاملة بمبيدات الحشائش جرانستار وجراسب (٨١ر٣٩، ٣٦ر٣٢ فرد/نبات) وبدون معاملة (٠٥ر٩٤، ٥٦ر٨٦ فرد/نبات) خلال عامى الزراعة ١٩٩٨/١٩٩٩ و ١٩٩٩/٢٠٠٠٠

3- أيضا أظهرت النتائج أن صنف القمح جيزة ١٦٤ وصنف سدس ٧ أقل حساسية للإصابة بالمن *S. graminum* مع غير المعاملة والمعاملة بمبيدات الحشائش السابقين (٢١ر١، ٨٣ر٠ فرد/نبات و٤٨ر٣، ٦٦ر٢ فرد/نبات) و (٩٨ر٠، ٥٨ر٠ فرد نبات و ٢٥ر٢، ٧١ر١ فرد/نبات) خلال العامين على التوالى٠

4- تم حدوث فقد لمبيد جرانستار ٥٠% من التركيز بعد ٩٧ر٥٠ و ٣٣ر٤٩ يوم لصنفى القمح جيزة ١٦٤ وسدس ٧ على الترتيب٠

5- حدث تدهور للمبيد جرانستار فى الأوراق حتى وصل لحوالى ٥٢ر٤ و ١٩ر٥ جزء فى المليون فى الصنفين جيزة ١٦٤ وسدس ٧ على الترتيب، ولم يتعرف على أى متبقيات للمبيد فى نهاية التجربة لكلا الصنفين بعد ١٧٠ يوم٠

6- حدث تدهور لمبيد جراسب ووصلت نسبة الفقد فى نهاية التجربة (بعد ١٥٥ يوم) إلى ٦٤ر٩٩ و٦٦ر٩٩% لكلا صنفى القمح جيزة ١٦٤ وسدس ٧ على الترتيب٠

7- كان تركيز مبيد جراسب الذى وصل للحبوب بعد ٩٥ يوم (٩١ر٠ و ١٢ر١ جزء فى المليون) لصنفى القمح جيزة ١٦٤ وسدس ٧ على الترتيب، ولم يتعرف على أى متبقيات فى الحبوب فى نهاية التجربة (بعد ١٥٥ يوم) لكلا الصنفين٠

٨- أشارت النتائج بأن مبيدى جرانستار وجراسب لهما تأثير أعلى على المحصول فى صنف القمح سدس ٧ عن الصنف جيزة ١٦٤، وكان التأثير أعلى فى محصول الحبوب للقمح فى الصنفين السابقين المعاملين عن القمح الغير معامل بمبيدات الحشائش السابقة فى المعاملة٠

Table(1): Mean population of the aphids *Rhopalosiphum padi* (L.) and *Schizaphis graminum* (Rondani) on two wheat varieties treated and untreated with herbicides at Fayoum Governorate during two successive seasons.

Date	1998 – 1999								1999 – 2000							
	R. padi				*S. graminum*				R. padi				*S. graminum*			
	Cids-7		Giza-164		Cids-7		Giza-164		Cids-7		Giza-164		Cids-7		Giza-164	
	Tr.	Untr.	Tr.	Untr.	Tr.	Untr.	Tr.	Untr.	Tr.	Untr.	Tr.	Untr.	Tr.	Untr.	Tr.	Untr.
November	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
December	-	1.6	-	2.1	-	-	-	-	-	1.3	-	1.9	-	-	-	-
January	-	52.6	-	56.2	-	1.6	4.2	12.6	-	48.6	-	51.3	-	1	3	10
February	124.3	265.6	58.2	93.6	-	2.1	3.1	8.3	102	239.3	49.3	87.9	-	1	2	6

March	91.2	203.6	35.9	45.6	3.9	5.2	-	-	73.3	194.6	22.6	34.3	2	4.3	-	-
April	23.6	39.9	6.2	12.2	2.0	4.6	-	-	18.3	35.6	2.3	8.6	1.5	4.0	-	-
Total	239.1	564.3	100.3	209.7	5.9	13.5	7.3	20.9	194.2	519.4	74.2	184	3.5	10.3	5.0	16
Mean	39.81	94.05	16.71	34.95	0.98	2.25	1.21	3.48	32.36	86.56	12.36	30.66	0.58	1.71	0.83	2.66

Table (2): Residual behavior of Granstare herbicide in soil and wheat plant under field conditions (ppm).

Varieties Samples / Time (days)	Giza-164						Cids-7					
	Soil	Loss %	*Leaves*	Loss %	Grain	Loss %	Soil	Loss %	*Leaves*	Loss %	Grain	Loss %
Zero	12.24	-	8.70	-	-	-	15.27	-	10.85	-	-	-
15	11.93	2.53	6.12	29.6	-	-	14.78	3.21	7.58	30.14	-	-
30	9.88	19.28	4.52	48.05	-	-	12.10	20.76	5.19	52.17	-	-
50	5.85	52.21	2.65	69.54	-	-	7.15	53.18	2.70	75.12	-	-
80	3.64	70.26	0.59	93.22	-	-	4.23	72.30	0.74	93.18	-	-
110	2.28	81.37	-	-	0.19	97.82	2.67	82.51	-	-	0.21	98.06
140	0.92	92.48	-	-	0.05	99.43	1.25	91.81	-	-	0.06	99.45
170	0.25	97.96	-	-	UND	100.0	0.29	98.10	-	-	UND	100.0
K (ppm. day^{-1})	50.97		26.97		72.96		49.33		25.23		77.45	
"t" 0.05 (days)	$1.360.10^{-2}$		$2.57.10^{-2}$		$9.53.10^{-2}$		$1.41.10^{-2}$		$2.75.10^{-2}$		$8.95.10^{-2}$	

Zero: 10 days after planting
UND: Undetectable
K : Rate of degradation
"t" 0.05: half-lives

Table (3): Residual behavior of Grasep herbicide in soil and wheat plant under field conditions (ppm).

Varieties Samples / Time (days)	Giza-164						Cids-7					
	Soil	Loss %	*Leaves*	Loss %	Grain	Loss %	Soil	Loss %	*Leaves*	Loss %	Grain	Loss %
Zero	22.30	-	12.06	-	-	-	26.68	-	14.59	-	-	-
15	19.93	10.63	9.52	24.44	-	-	22.73	14.81	10.74	26.39	-	-
30	17.28	22.51	6.01	52.30	-	-	19.85	25.60	5.63	61.41	-	-
50	12.01	46.14	1.50	88.10	-	-	12.92	51.57	2.10	85.61	-	-
80	8.69	61.3	-	-	0.91	92.78	9.05	66.08	-	-	1.12	92.32
125	3.91	82.47	-	-	0.20	98.41	5.40	79.76	-	-	0.25	98.29
155	0.08	99.64	-	-	UND	100.0	0.29	99.66	-	-	UND	100.0
K (ppm. day^{-1})	$1.39.10^{-2}$		$2.42.10^{-2}$		$1.20.10^{-2}$		$1.52.10^{-2}$		$2.58.10^{-2}$		$1.20.10^{-2}$	
"t" 0.05 (days)	49.66		28.66		57.78		45.63		26.86		57.78	

Zero: 10 days after planting
UND: Undetectable
K : Rate of degradation
"t" 0.05: half-lives

Table (4): Effect of Granstare and Grasep herbicides on growth characters and fresh yield crop (ardab/fed.) of two wheat varieties during the two successive seasons; 1998/1999 and 1999/2000.

Seasons / Varieties	1998/1999						1999/2000					
	Giza-164			Cids-7			*Giza-164*			Cids-7		
Treatment Characters	Control	Granstare + Grasep	Relative to control	Control	Granstare + Grasep	Relative to control	Control	Granstare + Grasep	Relative to control	Control	Granstare + Grasep	Relative to control

Spike length (cm)	8.125	5.25	64.6	8.625	4.625	53.6	8.150	5.75	70.5	8.6	4.8	55.8
No. of seeds/spike	45	27	59.4	44	17	38.6	46	29	63.0	43	19	44.2
No. of tillers/m^2	1533	516	33.7	1083	450	41.6	1569	523	33.33	1091	475	43.5
Fresh yield crops (ardab/fed.)	9.5	12.5	131.58	10.5	14	133.33	9.8	12.7	129.59	10.1	14.25	134.43

End of experiment: after 180 days of planting.