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RESPONSE OF FOLLOWING WINTER CROP SEED GERMINATION AND SEEDLING GROWTH TO RICE STRAW EXTRACT AND RESIDUES

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ABSTRACT

The allelopathic potential of rice straw cv. Giza 178 was evaluated on the germination and seedling growth of squash, turnip, lentil wheat, Egyptian berseem and flax. Germination percentage and rate of all studied crop seeds were not affected significantly by aqueous extracts of rice straw, except for the rate of germination of flax which was delayed by increasing the extract concentration. Shoot length of flax was inhibited by 10.2% with 0.1% dilution, but was stimulated for wheat shoot length by5.6% at undiluted extracts. Seedling length of turnip and flax was stimulated by 46.9& 16.2%, respectively, with undiluted extracts. Seedling growth response depended on the extract concentration. Squash seedling fresh weight was stimulated by 9.3% at undiluted extract. However all other crop seedling fresh weight was not significantly affected.

Residues from rice straw placed in pots of sand had no significant effect on the emergence percentage and rate of all studied crops, except for emergence percentage of Egyptian berseem and wheat which was increased and the rate of emergence of turnip and lentil which were delayed by increasing residue concentration. The flax emerged seedling shoot length and lentil seedling length were inhibited by 9.6% and 14.3%, respectively, in the presence of low rice straw residues as compared with control. The fresh weight of turnip, lentil, squash and wheat emerged seedling were stimulated by 3.3%, 8.4%, 22.8% and 26.4%, respectively, at higher residue concentration (1%).

The stimulation effect by undiluted extract, and higher residue concentration from rice straw tissue may contain water-soluble compounds that exert allelopathic effect on the growth of studied crops under controlled environmental and greenhouse conditions, and it may be recommend to incorporate rice straw in the soil at higher concentration under field conditions. However more research is needed to identify these possible allelopathic compounds and demonstrate their potential field conditions.

INTRODUCTION

Rice (*Oryza sativa* L.) is Egypt's most important exported field crop. Nowadays farmers in Egypt usually get rid of the large amount of rice straw after harvesting by burning in the field. This practice causes serious environmental problems in the village ecosystem and neighbor cities. Therefore, an advice was to bury rice residues and straw cuts in soil to improve soil conditions. In this respect, **Chou *et al* (1977) and Harpar (1977)** reported that soil with rice residues had higher phenolic and microbial activity which results in lower NH^-_4 and NO^-_3 levels than soil without rice residues. It was found, in Taiwan, that the rice residues buried in soil could release phototoxic substances during the decomposition period, especially under logged conditions **(Chou and Chiou, 1979; Chou *et al* 1981).**

Several investigations have reported allelopathic activity in rice and that allelopathic activity was plant parts and extract concentration dependent. Some allelopathic cultivars weakly affect the shoot **(Olofsdotter and Navarez,1996).** Concerning rice plant part, **Dilday *et al* (1992) and Rizk *et al* (2005)** reported that allelopathicals were pre-

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sented in rice straw, and the aqueous extracts of rice residues inhibited root growth of lettuce and rice seedling **Chou, (1998) and Ebana *et al* (2001)**.

Seedling emergence was not affected by the crop residues but the fresh and dry weights were significantly decreased by incorporation of residues (**Tamak *et al* 1993**). The aqueous extract of rice straw at 5 or 10% concentrations significantly inhibited seed germination and seedling growth of wheat, oat, Egyptian berseem and lentils compared with the control. Lentil germination was completely inhibited at highest straw concentration (**Tamak *et al* 1994**).

Depending on the concentration, some residue extracts caused great inhibition, other caused growth activation and the third had no significant effect (**Rice, 1984; Indejit and Olofsdotter, 1998**). Some workers demonstrated the allelopathic potential of rice residues. Laboratory bioassay has been an important way of rice allelopathy research, because they allow researches to study large amount of plant materials in a short time, and allow researches to eliminate inference factors other than the one under study (**Indejit and Olofsdotter, 1998**).

Putnam and Duke (1978), in their review of "allelopathy in agroecosystems" listed several methods for chemical extractions from plants. The large quantities of dried rice straw residues received by soil annually after harvesting are very important issue to investigate their effects on the following crop plants.

The objective of this research was to evaluate the effect of water extracts and residues of rice straw cultivar Giza 178 on germination and seedling growth of turnip, squash, lentil, Egyptian berseem, wheat and flax.

MATERIALS AND METHODS

Twelve laboratory and greenhouse experiments were carried out in 2006/ 2007, to study the effect of rice straw water extract on germination and seedling growth of turnip, squash, wheat, Egyptian berseem, lentil and flax. Experiments were performed at the Horticulture Department, Faculty of Agriculture, Ain Shams University.

Rice plant materials

Rice cultivar Giza 178 was used to obtain rice straw material for water extract and residue experiments. The straw of harvested plants of the selected rice cultivar was air dried. The dried part materials were ground to pass a 20-mesh screen in Wiley mill. This ground tissue was extracted with water for germination tests of the following crop seeds in vitro: turnip (*Brassica rapa)* cv Soltany, squash (*Cucurbita pepo*) cv. Escandarany, wheat (*Triticum aestivum*) cv. Sakha 8, Egyptian (Egyptian berseem) (*Trifolium alexandrinum*) cv. Sakha 86, lentil (*Lens culinoirs*) cv. Giza 9 and flax *(Lenium ussitatismum*) cv. Giza 8.

1- Rice straw water extract experiments

Water extract from rice straw was prepared separately according to **Abdallah *et al* (1989)** as follows: 2.5 g of dried ground straw tissue were placed in a 500-ml Erlenmeyer flask with 250 ml of deionized water and the mixture was shacked for 6 hours on a horizontal shaker (160 cycles per minute). All water extract was filtered through Whatman No.1 and the aqueous extract was frozen until required.

Petri-dishes (12.5 cm diameter) were sterilized in an autoclave at 121°C for 15 minutes and lind later with Whatman No.1 filter paper as a seedbed as reported by **Abdallah *et al* (2002)**. The frozen extract was thawed and then diluted, ten, hundred and thousand fold to be evaluated on germination and seedling growth of some vegetable and field crops. Ten-milliter of each undiluted and diluted extracts or of deionized water (control) were added to the Petri-dishes containing 25 seeds of each crop except for squash 10 seeds. The Petri-dishes were covered and placed in controlled environment chamber (continuous dark) which provide a constant temperature of 20°C for turnip, wheat, Egyptian berseem, lentil and flax and of 29°C for squash according to **ISTA (1996)**.

Petri-dishes for each individual crop were arranged in completely randomized design with four replications per treatment. Each experiment was conducted twice. The germination percentage and rates of germination were recorded after adequate period of each crop according to **ISTA (1996)**. The seedling length (radical and hypocotyls or plumule) as well as fresh weight were also assessed after 7days from sowing date for studied crops.

2. Rice straw residue experiments

The objective of this research was to determine the allelopathic effect of rice straw residues of the selected rice cultivar Giza 178 on emergence percentage and seedling of turnip, squash, wheat, Egyptian berseem, lentil and flax under net greenhouse condition. Pots (10 cm diameter) were initially filled with previously washed sand and carefully mixed with the ground residues at the rates of 0.0, 0.1, 0.2, 0.3 and 0.4% (w/w). Twenty seeds of each crop per pot except for squash ten seeds were sown on the surface and covered with additional mixed sand to give a final equal weight for each pot (400 gm).

Pots received initially watering of 50 ml of tap water and additional volumes of the same water were added at 24- hour intervals, to bring all pots to saturation. After seedling emergence, pots were irrigated with half- strength Hoagland's solution at 48- hour intervals. Emerged seedlings of each pot were recorded daily and seedlings were thinned to five seedlings per pot. Subsequently, new emerged seedlings were recorded and thinned daily, however, data were recorded on the five selected seedlings and statistically analyzed for each crop separately.

Statistical Analyses

All data of each experiment were subjected to the appropriate statistical analysis as completely randomized design (CRD) according to **Snedecor and Cochran (1980).** Treatment means were compared by using the least significant difference test (L.S.D.) at 0.05 level of significance. The combined analysis of the data of the two experiments was used

RESULTS AND DISCUTION

1- Effect of rice straw water extract

A- Seed germination

Data in **Table (1)** indicate that the effects of rice straw aqueous extract on germination percentage and rate of turnip, Egyptian berseem, lentil, squash, wheat and flax were not significant except for germination rate of flax which increased by increasing the extract concentration. The delaying percentage was about 0.3 day at undiluted extract comparing with control.

Seedling growth response depended on the extract concentration. The non significant effects of rice straw aqueous extracts revealed that rice straw has no effect on winter crop seed germination.

B- Seedling growth

Data in **Table (2)** indicate that seedling shoot length, total length and fresh weight of all studied plant species were not significantly affected by the extract of rice straw, except for wheat and flax seedling shoot length ;turnip and flax seedling length and squash seedling fresh weight which were increased with increasing the extract concentration. The seedling shoot length of wheat and flax were stimulated by 5.8 % and 4.1 % respectively at undiluted rice straw extract. Also turnip and flax seedling length were stimulated by 46.9% and 16.2% respectively, while squash seedling fresh weight was stimulated by 9.3% at undiluted extract as compared with control. The results from the present experiments indicate that dried rice straw of Giza 178 cultivar may contain water soluble compounds which exhibit allelopathic effects on turnip, flax, squash and wheat seedling growth under controlled environmental conditions. The stimulated characters indicate that rice extracts possibly contain stimulator substances which reflected such response. This agrees with **Rizk *et al* (2005)** who reported that undiluted rice straw of Sakha 102 cultivar increased significantly fresh weight of peas seedling.

2- The effect of rice straw residues on

A- Seedling emergence

Data in **Table (3)** showed that there were no significant effects for rice straw residues on percentage and rate of emergence of squash and flax. Whereas, the emergence percentage of Egyptian berseem and wheat and the rate of emergence of turnip and lentil were increased with increasing the rice straw residue concentration in pots. However turnip and lentil emergence rate was enhanced by about 0.4 and 1.0 day respectively with 0.25 residue as compared with control.

B- Seedling growth

Data in **Table (4)** showed that there were no significant effects for rice straw residues on seedling shoot length of turnip, lentil, squash and wheat; on seedling length of turnip, Egyptian berseem, squash, wheat and flax and on seedling fresh weight of Egyptian berseem and flax. Egyptian berseem seedling shoot length was stimulated significantly with increasing rice residue concentration while flax seedling shoot length was inhibited significantly with decreasing rice straw residue concentration as compared with control.

Table 1. Effect of rice straw aqueous extract dilution (%) on turnip, Egyptian berseem, lentil, squash, wheat and flax seed germination and rate (means of two experiments)

Extract dilution	Turnip	Egy.berseem	Lentil	Squash	Wheat	Flax
	Germination percentage					
0.0 %	78.8	99.5	96.0	88.8	100.0	86.0
0.1 %	80.3	99.5	96.8	87.5	99.5	85.3
1 %	81.3	98.5	97.3	89.4	99.5	87.0
10 %	82.0	99.5	98.0	89.4	100.0	89.5
Undiluted	83.1	99.0	98.3	87.5	100.0	81.0
L.S.D at 0.05	NS*	NS	NS	NS	NS	NS
	Rate of germination (Days)					
0.0 %	1.42	1.15	1.21	2.60	1.09	1.92
0.1 %	1.48	1.21	1.25	2.88	1.05	1.88
1 %	1.51	1.26	1.31	3.02	1.09	2.10
10 %	1.53	1.31	1.34	3.04	1.08	2.16
Undiluted	1.59	1.35	1.49	2.88	1.10	2.20
L.S.D at 0.05	NS	NS	NS	NS	NS	0.22

NS*= Not Significant

Table 2. Effect of rice straw aqueous extract dilution (%) on turnip, Egyptian berseem, lentil, squash, wheat and flax shoot length, seedling length and seedling fresh weight (means of two experiments)

Extract dilution	Turnip	Egy.berseem	Lentil	Squash	Wheat	Flax
	Seedling shoot length (cm)					
0.0 %	4.57	4.43	6.65	8.2	10.4	9.8
0.1 %	4.88	4.35	6.70	9.5	10.3	8.8
1 %	5.26	4.40	6.8	9.7	10.4	9.5
10 %	5.50	4.42	7.0	9.96	10.8	10.0
Undiluted	5.51	4.45	7.1	10.0	11.0	10.3
L.S.D at 0.05	NS	NS	NS	NS	0.5	0.6
	Seedling length (cm)					
0.0 %	9.53	8.76	11.8	17.1	24.7	14.2
0.1 %	10.78	8.76	12.2	18.6	23.1	13.1
1 %	11.61	8.96	12.9	19.0	25.4	14.9
10 %	11.91	9.07	13.1	19.4	25.8	15.5
Undiluted	14.00	9.18	13.2	19.9	26.2	16.5
L.S.D at 0.05	1.29	NS	NS	NS	NS	1.5
	Seedling fresh weight (g)					
0.0 %	0.052	0.047	0.171	0.843	0.321	0.097
0.1 %	0.060	0.048	0.178	0.846	0.314	0.089
1 %	0.061	0.049	0.179	0.860	0.328	0.095
10 %	0.064	0.050	0.183	0.865	0.334	0.096
Undiluted	0.071	0.051	0.186	0.921	0.347	0.098
L.S.D at 0.05	NS	NS	NS	0.070	NS	NS

Table 3. Effect of rice straw residues on turnip, Egyptian berseem, lentil, squash, wheat and flax emergence percentage and rate. (means of two experiments)

Residue	Turnip	Egy.berseem	Lentil	Squash	Wheat	Flax
	Emergence percentage					
0.0	76.5	67.5	87.0	45.0	84.5	78.8
0.25	70.6	56.5	76.5	38.0	88.0	77.5
0.50	71.8	73.0	83.5	40.5	92.0	80.0
0.75	72.6	75.5	85.0	42.0	93.1	82.6
1.0	80.1	86.0	88.0	48.0	94.5	86.0
L.S.D at 0.05	NS	10.4	NS	NS	7.2	NS
	Rate of emergence (Days)					
0.0	6.54	7.51	8.68	12.54	6.30	7.95
0.25	6.90	7.41	7.70	11.98	6.38	7.42
0.50	7.51	7.57	8.44	12.77	6.47	7.55
0.75	8.08	7.83	8.79	13.01	6.50	7.73
1.0	8.13	7.90	9.12	13.02	6.70	7.97
L.S.D at 0.05	0.80	NS	0.70	NS	NS	NS

Table 4. Effect of rice straw residue on, turnip, Egyptian berseem, lentil, squash, wheat and flax shoot length, seedling length and seedling fresh weight (means of two experiments)

Residue	Turnip	Egy.berseem	Lentil	Squash	Wheat	Flax
	Emerged shoot length (cm)					
0.0	6.34	6.17	7.26	16.25	21.88	8.45
0.25	5.65	6.56	6.78	14.74	22.66	7.64
0.50	5.69	6.97	6.99	15.91	22.84	7.88
0.75	5.80	7.04	7.16	16.95	23.17	7.89
1.0	6.04	7.09	7.48	18.13	23.49	7.97
L.S.D at 0.05	NS	0.41	NS	NS	NS	0.51
	Emerged seedling length (cm)					
0.0	17.44	16.21	20.3	28.1	43.3	25.9
0.25	15.50	15.17	17.4	25.8	43.8	24.5
0.50	15.71	15.46	18.1	27.9	44.4	25.4
0.75	16.61	15.58	19.4	28.8	44.7	25.6
1.0	17.81	15.69	20.7	30.8	44.9	25.9
L.S.D at 0.05	NS	NS	2.5	NS	NS	NS
	Emerged seedling fresh weight (g)					
0.0	0.945	0.231	0.606	4.080	1.620	0.351
0.25	0.660	0.223	0.487	3.781	1.766	0.306
0.50	0.677	0.242	0.520	3.854	1.918	0.344
0.75	0.759	0.244	0.578	4.487	1.959	0.354
1.0	0.976	0.258	0.657	5.010	2.047	0.366
L.S.D at 0.05	0.210	NS	0.100	0.770	0.190	NS

However, emerged lentil seedling length inhibited significantly at low rice residue concentration (0.25%) only. Concerning emerged seedling fresh weight data in **Table (4)** showed that turnip and lentil seedling weight decreased significantly with low rice straw residue concentration as compared with control. On the other hand, the higher rice straw residue concentration (1.0%) increased significantly turnip, lentil, Squash and wheat seedling fresh weight as compared with control. Moreover, wheat seedling fresh weight was stimulated significantly from 9.0% to 26.4% with increasing rice straw residue concentration. The results from these experiments indicated that residues from rice straw released water soluble compounds that exert allelopathic effect on emergence and seedling development of studied crops. Moreover, the stimulatory and inhibitory effects of rice residues may possibly due to stimulating and inhibiting substances. Also, rice residues in sand increased water availability for seedling crops with no drought stress as reported by **Abd- Elaziz (2006).**

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إستجابة إنبات بذور ونمو بادرات المحاصيل الشتوية اللاحقة لمستخلص وبقايا قش الأرز

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المقدمــــه

أجريت ١٢ تجربة فى المعمل والـصوبة بقـسم البساتين - كلية الزراعة - جامعــة عــين شــمس لدراسة تأثير المستخلص المائى الناتج عن مطحــون قش الأرز وتأثير بقايا قش الأرز بالتربة لصنف جيزه ١٧٨ على نسبة وسرعة الإنبات بالمعمــل ونـسبة وسرعة إنبثاق البادرات فوق سطح التربة بالـصوبة وصفات نمو بادرات بعض المحاصيل الشتوية اللاحقة " اللفت والبرسيم المصرى والعدس والكوسة والقمــح والكتان"

وخلصت النتائج المتحصل عليها كالاتى:

١) بالنسبة لتاثير المستخلص فــى تجــارب الإنبــات المعملية (فى أطباق بترى) لم تتأثر معنوياً نـسبة وسرعة الإنبــات لمعظــم المحاصــيل الـشتوية بالمستخلص المائى من قش الأرز ما عدا ســرعة إنبات بذور الكتان التى تــأخرت بزيـــادة تركيــز المستخلص ، ونجد أن إستجابة نمو البادرات يعتمد على تركيز المستخلص حيث تم تثبيط طول النمو الهوائى لبادرةالكتان بنسبة ١٠,٢ ٪ مع التركيــز المخفف من المــستخلص (٠,١٪) ولكــن كــان تركيز المستخلص غير المخفف الأثر المحفز للنمو بنسبة ٥,٨٪ و ٤٦,٩ ٪ و ١٦,٢ ٪ لطول النمو الهوائى لبادرات القمح والطول الكلــى لبــادرات اللفت والكتان على التوالى ، ومن ناحية أخــرى ازداد الوزن الطازج لبادرات قرع الكوسة بزيادة تركيز المستخلص بينما لم يتأثر معنوياً طول النمو الهوائى والطول الكلى للبادرة والــوزن الطــازج لباقى بادرات المحاصيل تحت الدراسة.

٢) أما بالنسبة لتأثير متبقيات قش الأرز فإن مطحون قش الأرز الذى تم وضعه فــى أكــواب الرمــل المغسول بمعدلات مختلفة داخل الصوبة لم يكــن لها تأثير معنوى على نسبة وسرعة إنبثاق بادرات معظم المحاصيل تحت الدراسة ما عــدا البرســيم المصرى والقمح حيــث زادت نــسبة الإنبثــاق لبادراتهما بزيادة كمية بقايا القش فــى الأكــواب وكذلك سرعة الإنبثاق لكل من اللفــت والعــدس والتى تأخرت بزيادة معدلات إضافه بقايا القــش . أما بالنسبة لطول النمو الهوائى لبادرة البرســيم المصرى والكتان والطول الكلى لبادرة العدس فقد تم تثبيطها بنسبة ٦,٣٪ و ٩,٦ ٪ و ١٤,٣ ٪ على التوالى بإضافه التركيز المنخفض من بقايا القش . وبالنسبة للوزن الرطب للبادرات أظهرت النتــائج قلة الوزن لبادرات كل من اللفت والعدس معنويــاً بإستخدام التركيزات المنخفضة من بقايا القش بينما استخدام التركيز المرتفع من بقايــا القــش (١٪)

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أظهر زيادة معنوية فى الوزن الرطب لبادرات اللفت والعدس وقرع الكوسة والقمح وصلت إلى ٣,٣٪ و ٨,٤ ٪ و ٢٢,٨٪ و ٢٦,٤٪ على التوالى مقارنة بمعاملة الكنترول.

هذا والتأثير المحفز للتركيز المرتفع للمستخلص المائى والمعدل المرتفع لبقايا قش الأرز ربما يرجع الى إحتوائه على مركبات ذائبة فى الماء والتى تؤثر على النمو للمحاصيل تحت الدراسة فى ظروف المعمل أوالصوبة . حيث يمكن التوصيه بقلب قش الأرز فى التربة ولكن يتطلب الأمر إجراء المزيد من الأبحاث لتحديد المركبات الأليلوباثية المتحصل عليها لإظهار إمكانياتها تحت ظروف الحقل .