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EFFECT OF PLANTING METHODS AND SOME HERBICIDES ON WEEDS AND RICE *(Oryza sativa,* L.*)* CROP PRODUCTIVITY

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ABSTRACT

Two field experiments were conducted in Gemmeiza Agric. Res. Station, Gharbia Governorate, Egypt, during 2017 and 2018 summer seasons to study the effect of interaction between three planting methods (broadcasting, dibbling and transplanting) and eight weed control treatments (Saturn 50% at the rate of 1.0 L fed^{-1}, Saturn at rate of 2.0 L fed^{-1}, Saturn at rate of 1.0 L fed^{-1} + Basagran at rate of 1.5 l fed^{-1}, Saturn at rate of 2.0 l fed^{-1} + Basagran at rate of 1.5 L fed^{-1}, Saturn at rate of 1.0 l fed^{-1} + Inpul at rate of 20 g fed^{-1}, Saturn at rate of 2.0 l fed^{-1} + Inpul at rate of 20 g fed^{-1}, Hand weeding twice, and unweeded check) on weed species susceptibility to herbicides and rice productivity. A split plot design with four replicates was used , planting methods were assigned in the main plots and weed control treatments were distributed randomly in sub plots. The results revealed that transplanting and dibbling methods reduced the dry weight of total weeds at 65 days after planting (DAP) by (33.4 and 13.8%) and (33.6 and 12.5 %) in the two seasons, respectively, as compared with broadcasting method. The same trend occurred in the econd survey at 85 DAP. The transplanting and dibbling methods significantly increased rice yield by (16.32 and 6.75%) and (15.22 and 6.31%) in both seasons as compared with broadcasting method. Herbicidal combinations of (Saturn 2.0 Lfed^{-1} + Inpul 20 g fed^{-1}), (Saturn 2.0 Lfed^{-1} + Basagran 1.5 lfed^{-1}), (Saturn 1.0 l fed^{-1} + Inpul 20 g fed^{-1}), (Saturn 1.0 l fed^{-1} + Basagran 1.5 l fed^{-1}) and hand weeding twice decreased dry weight of total weeds by 88.6, 86.6, 84.2, 82.4 and 79.0 %, in the first season at 65 DAP respectively as compared to the unweeded check, these results had the same trend in the second survey and second season. On the other hand, increased straw yield by (46.7, 46.5, 37.9, 37.8 and 29.0%) and grain yield by (51.0, 51.1, 40.2, 40.3, and 33.4 %), respectively, in the first season. The interaction between planting methods and weed control treatments were statistically significant on dry weight of total weeds. Transplanting and dibbling methods were superior by (27.6 and 11.4%) and (29.2 and 8.5%), respectively as compared with broadcasting method under unweeded check conditions in the two seasons. The best interaction between planting methods (transplanting and dibbling) with combination for weed control (Saturn 2.0 l fed^{-1} + Inpul 20 g fed^{-1}), (Saturn 2.0 l fed^{-1} + Basagran 1.5 l fed^{-1}) which decreased the dry weight of total weeds by 92.6 and 89.6 % at 65 DAP, as compared to unweeded check of broadcast, and increased the grains yield about 67.5 and 65.5 % as compared to unweeded check of broadcast method. The perivous results showed that weed stress was lower on rice yield under transplanting or dibbling methods than broadcasting method, due to the elimination of weed competition by these herbicide combinations . It is recommended to expand rice planting by broadcasting method and avoid the problem of well-trained labor and their high cost. Thus, farmers can expand in the cultivated rice broadcasting or dibbling methods for increase economic return to farmers.

Key words: *planting methods, broadcasting, dibbling, transplanting, Oryza sativa, L., Weed Control, Cyperus difformis, Cyperrus rotundus, Echinochloa colonum, Dinebra retroflex, Ammannia auriculata, Eclipta alba.*

1. INTRODUCTION

Rice *(Oryza sativa,* L.*)* is one of the most important summer cereal crops in Egypt, and is considered as a daily popular diet. Raising rice productivity per land area unit is very essential issue to meet the consistently increasing population demands. Planting methods for growing rice varied from transplanting to broadcasting or dibbling methods in Egypt. Transplanting method is a familiar method but,

requires high cost with well-trained labors, then direct broadcasting or dibbling methods, but weed infestation is considered the main obstacle in adopting the latter planting methods. Shedding lights on the performance of herbicides on weeds and rice productivity, and its economic feasibility under these three familiar planting methods is necessary for solving weed problem in rice plantation.

The input requirements and the investment in direct seeded rice are much lower than in transplanted rice (Sunil *et al*., 2002). Dibbling is a new planting methods, used, firstly, by farmers in the Dakahlia Governorate, and increased in recent years, particularly that transplanting rice needs well-trained labors for the transplanting, those adapted by the RRTC (2002). Ali *et al*. (2013) revealed that the highest plant height, number of productive tillers, number of panicle count, root length, seed index, straw yield and cost benefit ratio were recorded in line with transplanting technique as compared to direct seed dibbling, direct seed drill and germinated seed broadcast. Based on the obtained, results it can be concluded that in areas where labour is available and cheap, transplanting is a better rice planting method because it produces more yield and gross economic return than other methods. Javaid *et al*. (2012) indicated that transplanting technique had the maximum number of tillers and panicles per unit area, spikelet's per panicle and paddy yield than other seeding techniques.

Weed control plays an important role in increasing rice productivity, which causes high losses varying from 35 – 100 % if weeds left associated with plants as mentioned by Kumar *et al.* (2008), and (Maity and Mukherjee (2008), in wet direct-seeded rice. Singh *et al*. (2009) reported from 30-90%, and Mamun *et al*. (2013) reported 47% losses in grain yield. Sheeja *et al*. (2013) reported 72 % reduction in grain yield. Estorninos *et al*. (2005) found that the number of tillers decreased from 20 to 48 % with increase of weeds density from 25 to 51 plants per m^{-2}. Jagtap *et al*. (2018) found that when herbicides were applied alone , although economical may have limitation of resistance development and shift in weed flora. Therefore, presently there is a need to use high efficacy herbicides, in combination with broad spectrum nature, to control the complex of weed flora in rice. Cavanna *et al.* (2004) and Zhang *et al*. (2005) stated that the combination of fenoxaprop with bentazon controlled effectively both broad and narrow leaved weeds and increased rice grain yield. Mousa and Noreldin,(2015) and Yousefnia *et al*. (2012) indicated that herbicide application and hand weeding once gave the highest grain yield (4584 kg ha^{-1}), as compared with unweeded check due to high unfilled grain/ panicle and less panicle number / square meter which had the lowest grain yield (2505 kg ha^{-1}). Jamshid *et al.* (2012) indicated that thiobencarb in combination bentazon and propanil; oxadiargyl mixed with bentazon and propanil; butachlor with mixed of bentazon and propanil gave 3454, 3390 and 3349 kg/ha yield, respectively, as compared with three-time hand weeding treatment (3044 kg ha^{-1}). Ghalwash *et al.* (2019) showed that application (Saturn 2l fed^{-1}. + Inpul 20 g fed^{-1}.), (Saturn 2l fed^{-1}.+ Basagran 1.5 2l fed^{-1}.) and (hand weeding twice) increased grain yield by 43.97, 59.1and 30.2 %, respectively as compared to the untreated check. Economic feasibility study of various weed management package results clearly can be grow rice under broadcasting method (Tagour *et al.*, 2016).

The objective of the present work was to evaluate the effect of some weed control treatments on weed control and rice crop performance under the three familiar planting methods namely broadcasting, dibbling as compared with transplanting method in Gharbia Governorate, Egypt.

2. MATERIALS AND METHODS

Two field experiments were conducted at Gemmeiza Agricultural Research Station Farm, Gharbia Governorate, Egypt, during 2017 and 2018 summer seasons. The experiments aimed to study the effect of weed control treatments on rice growth and yield productivity under different planting methods, on clay soil shown in Table (a) according to Jackson (1973).

Rice (*Oryza sativa*, L.) variety Sakha 101 was grown . The preceding winter crop was sugar beet (*Beta vulgaris*, L.) in both sowing seasons. Seeded rice three sowing methods were broadcasted, dibbling and transplanting at 15 and 20 May in the first and second seasons, respectively, at a rate 50 kg fed^{-1}. The rice seeds were pre-soaked in water for 24 hours and incubated for 36 hours prior to seeding. The other agricultural practices for rice production in the region were followed. The adopted experimental treatments were laid out in split - plot design with four replicates. Sub plots area was 10.5 m^2 (3.0 m x 3.5 m). Each experiment

Table (a): Particle size distribution and some chemical properties of the experimental soil in 2017 and 2018 seasons.

Seasons	Particle size distribution			Soil texture	Chemical analyses						
	Sand %	Silt %	Clay %		EC (dsm^{-1}) (1:5)	pH (1:1)	Organic matter %	Available (mg kg^{-1})			
								Total N (%)	P (ppm)	K (ppm)	Zn (ppm)
2017	12.2	34.0	53.8	Clay	1.19	7.85	1.12	0.54	8.01	410.0	1.42
2018	13.5	35.2	51.3	Clay	1.74	8.06	1.62	0.43	8.05	375.0	0.87

included twenty four treatments, which were the combination of three planting methods added in the main plots and eight weed control treatments in sub plots as follows:

2.1. The main plots (planting methods)

1. Broadcasting by 50 kg grains rice.

2.Dibbling by 10 grains per hill at 20 x 20 cm distance between hills and rows.

3. Transplanting: rice transplants 30 days of age sown at 20 x 20 cm distance between hills and rows.

2.2. The sub- plots (Weed control treatments)

1. Saturn 50% EC (thiobencarb) [S-4-chlorobenzyl diethyl (thiocarbamate)] at the rate of 1.0 l fed^{-1}., applied at 7 days after planting (DAP).

2. Saturn 50 % EC at the rate of 2.0 l fed^{-1}., applied at 7 was (DAP).

3. Saturn 50 % EC at the rate of 1.0 l fed^{-1}., applied at 7 (DAP) + Basagran 48 % AS (bentazon) [3-isopropyl-1 H-2, 1, 3-benzothiadiazin-4(3H)-one 2, 2-dioxide] at the rate of 1.5 l fed^{-1}., applied at 15 DAP.

4. Saturn 50 % EC at the rate of 2.0 l fed^{-1}., applied at 7 DAP + Basagran 48 % AS at the rate of 1.5 l fed^{-1}., applied at 15 (DAP).

5.Saturn 50 % EC at the rate of 1.0 l fed^{-1}., applied at 7 DAP + Inpul 75 % WG (halosulfuron-methyl) [methyl 3-chloro-5-(4,6-dimethoxypyrimidin-2-yl carbamoyl sulfonyl) -1-et hylpyrazole-**2.2.** carboxylate] at the rate of 20 g fed^{-1}., applied at 15 DAS.

6. Saturn 50 % EC at the rate of 2.0 l / fed., applied at 7 DAP + Inpul 75 % WG at the rate of 20 g fed^{-1}., applied at 15 DAP.

7. Hand weeding twice, at 30 and 45 DAP.

8.Unweeded check (control).

2.3.Data recorded

1.Dry weight of weed plants (g m^{-2})

A sample of weed plants were taken randomly from one square meter from each sub-plot at 65 and 85 DAP and dried at 70℃ till the constant weight , and dry weight was determined as g m^{-2}.

2.3.2.Weed species susceptibility to herbicides

Susceptibility index was measured according to Frans and Talbert (1977) as follows:

1. Susceptible (S) = >90%.

2. Moderately susceptible (MS) = >80-90%.

3. Moderately tolerant (MT) = > 60-79%.

4. Tolerant (T) = < 60%.

2.3.3. Rice yield and its components

At harvest, ten guarded rice plants were hand pulled randomly from each sub-plot to determine plant height (cm), panicle length(cm), number of panicle m^{-2}, number of full grain $panicle^{-1}$, 1000-grain weight (g), and all plants of the whole plot were harvested to determine straw and grain yields, which expressed as ton fed^{-1}.

2.3.4. Economic feasibility

According to Heady and Dillon (1961), the economic evaluation for grain yield of rice (ton fed^{-1}),variable costs, gross income (GI), profitability and benefit/cost ratio (B/C) were calculated according to Dunan *et al*. (1995), as follows:

1.Total costs (costs, fertilization, irrigation, insect and pathogens control, harvesting and rental value per fed. of land preparation, planting, post sowing activities).

2. Gross income (GI) = (price ton fed^{-1} LE Egyptian pound) x (grain yield ton fed^{-1} + straw yield ton fed^{-1}).

3. Net income (NI) = gross income – total costs.

4.Profitability (P) = (net income/total costs).

5.Benefit/Costs Ratio (B/C) = gross income/total costs.

2.5. Statistical analysis was carried out according to Gomez and Gomez (1984) using "MSTATC" computer software**.** The means values were compared at 5 % level of significance by using L.S.D. test.

3. RESULTS AND DISCUSSION

3.1. Effect of planting methods

3.1.1. Dry weight of weeds

Data in Table (1) show that the dominant weed species under the three planting methods were grassy weeds *(Echinochloa colonum* L.) and *(Dinebra retroflexa* Vahl) and (*Ammannia auriculata,* Willd) and *(Eclipta alba* L.) as broad-leaved weed species and *(Cyperus difformis* L.*)* and *(Cyperus rotundus* L.) as Sedges weeds in both 2017 and 2018 seasons. Data in Table (1) show that both transplanting or dibbling methods exalted significant reduction in dry weight of different weed species dominant in rice fields at 65 and 85 days after planting (DAP) in 2017 and 2018 seasons. Dry weight of total weeds were reduced by 33.2 and 13.8 percent at 65 DAP and 34.9 and 14.2 percent at 85 DAP in 2017 season. The sequence decreases in 2018 season were 33.6 and 12.5 percent with on 31.0 and 9.1 percent with respective tow planting methods by either transplanting or dibbling methods respectively. These results were in agreement with those obtain by Ali *et al*. (2013).

3.1.2. Yield and its components

Data in Table (2) show that the planting methods had significant effects on grain and straw yields and yield attributes of rice in both 2017 and 2018 seasons. Transplanting and dibbling methods exerted higher yield components namely, panicle length, number of panicles m^{-2}, number of full grain panicle, 1000-grain weight, during 2017 and 2018 seasons, than broadcasting method. Plant height had effects in the both seasons. Grain yield tended to increase under transplanting and dibbling methods by (16.32 and 6.75 %) in 2017 and (15.22 and 6.31 %) in 2018, respectively. These increments were positively correlated with different yield attributes. These may be attributed that planting rice early by 30 days transplants age can compete strongly with weeds under transplanted method them other planting methods which weeds when grow faster than rice seedlings in the same time and dibbling planting method can rice seedlings compete relatively due to planting with number of seeds per hills than broadcasting planting methods. Similar results were obtained by Ali *et al*. (2013) and Javaid *et al*. (2012) who revealed that the highest grain yield, plant height, number of productive tillers, number of panicle count, root length, seed index, straw yield and cost benefit ratio were recorded in line transplanting.

3.1.3. Economic feasibility

Data in Table (3) showed that the differences among all the studied economic criteria as affected by three planting methods that total gross income was significantly increased by transplanting and dibbling methods than sauce broadcasting methods. The highest net income (LE fed^{-1}) which gave (8744 and 8317 LE fed^{-1}) and (9506 and 8553 LE fed^{-1}) in the first and the second seasons, respectively, and were reduced (7810 and 8357 LE fed^{-1}) with broadcasting in both seasons. Those results agree with Ali *et al*. (2013) and Jagtap *et al*. (2018).

3.2. Effect of weed control treatments

3.2.1.Weed species susceptibility to herbicides

Table (4) show weeds species susceptibility % herbicides to the used according to rating system described by Frans and Talbert (1977), show the efficiency of the applied herbicides on six weed species, depending on the scale of weed susceptibility that concerning to control and susceptibility %, data revealed that grassy weeds (*Echinochloa colonu*a L.) was more susceptible to Saturn 2Lfed^{-1}, while, (*Echinochloa colonu*a L.) and *(Cyperus difformis* L.*)* were more sensitive to than(Saturn 2Lfed^{-1} + Basagran 1.5 l fed^{-1}) and (Saturn 2Lfed^{-1} + Inpul 20 g fed^{-1}) combination. On the other hand, (*Ammannia auriculata* Willd) and *(Eclipta alba* L.) as broad-leaved weeds and; *(Cyperus rotundus,* L.) as sedges at 65 DAP, were tolerant for Saturn 2.0 and 1.0 l fed^{-1}. meanwhile *(Dinebra retroflexa,* Vahl) was moderately tolerant with all used herbicides at both 65 and 85 DAP, in 2017 season, *Echinochloa colonu*a, L. was sensitive to (Saturn 2Lfed^{-1} + Basagran 1.5 l fed^{-1} or Inpul 20 g fed^{-1}) in 2017 season, but it was moderately susceptibility to other treatments.*(Ammannia auriculata,* Willd) and (*Eclipta alba* L.) and (*Cyperus rotundus,* L.) was tolerant to (Saturn 1.0 and 2.0 lfed^{-1}) at 65 DAS in 2017 season, while was moderately susceptible to the other treatments.

The most effective treatments in controlling total annual weeds in both seasons where gave hand weeding twice treatment by 78.9 and 80.6 %, hile, (Saturn 2l fed^{-1} + Inpul 20 g fed^{-1} or

Table (1): Effect of planting methods on dry weight of weeds (gm^{-2}) at 65 and 85 days after planting in 2017 and 2018 seasons.

Planting methods	Dry weight of weeds ($g\ m^{-2}$)						Total weeds
	E. colonum	*D.retroflexa*	*A. auriculata*	*E. alba*	*C. difformis*	*C. rotundus*	
2017 season							
65 DAP							
Broadcasting	10.3	8.6	8.6	15.8	9.0	4.1	56.4
Dibbling	8.8	7.5	8.1	12.9	7.6	3.7	48.6
Transplanting	7.5	6.8	6.2	9.2	5.0	3.0	37.7
L S D $_{0.05}$	0.36	0.38	0.53	0.84	0.51	0.23	2.75
85 DAP							
Broadcasting	62.5	44.4	27.5	44.2	43.1	15.1	236.8
Dibbling	52.1	40.5	25.4	34.5	39.1	12.2	203.8
Transplanting	40.8	33.6	21.0	23.3	24.4	11.1	154.2
L S D $_{0.05}$	4.47	2.26	1.38	4.30	4.06	0.85	17.15
2018 season							
65 DAP							
Broadcasting	11.8	9.2	7.6	17.3	9.8	5.1	60.8
Dibbling	10.4	8.6	6.8	14.5	8.4	4.5	53.2
Transplanting	8.3	7.2	5.4	10.2	5.6	3.6	40.4
L S D $_{0.05}$	1.69	1.06	0.89	1.54	1.22	0.60	3.16
85 DAP							
Broadcasting	52.5	35.6	25.9	51.4	40.6	19.3	225.3
Dibbling	49.1	33.2	23.7	43.8	37.3	17.8	204.9
Transplanting	38.3	27.3	20.1	31.4	22.7	15.6	155.4
L S D $_{0.05}$	1.88	1.77	2.52	6.39	5.57	2.25	9.85

Table (2): Effect of planting methods on yield and its components in 2017 and 2018 seasons.

Planting methods	Plant height (cm)	Panicle length (cm)	No. Panicles m^{-2}	No. full grain $panicle^{-1}$	1000 grain weight (g)	Straw yield (ton fed^{-1})	Grain yield (ton fed^{-1})
	2017 season						
Broadcasting	90.7	24.1	299.3	120.8	23.22	4.43	3.18
Dibbling	94.0	24.6	320.1	137.8	23.27	4.67	3.41
Transplanting	96.4	24.9	329.4	148.7	24.05	4.93	3.80
L S D $_{0.05}$	1.39	0.19	7.30	6.67	0.20	0.13	0.14
	2018 season						
Broadcasting	88.1	23.5	295.1	118.6	23.06	4.39	3.12
Dibbling	92.2	24.3	316.3	135.5	23.43	4.58	3.33
Transplanting	94.5	24.5	323.2	146.2	24.01	4.84	3.68
L S D $_{0.05}$	1.73	0.29	7.79	5.74	0.32	0.23	0.21

Table (3): Effect of planting methods on economic analysis of rice crop during 20l7 and 2018 seasons.

Planting methods	Total cost LE $fed.^{-1}$	Gross income LE $fed.^{-1}$	Net income LE $fed.^{-1}$	Profitability	Benefit / Costs Ratio
2017 season					
Broadcasting	6396	14206	7810	1.22	2.23
Dibbling	6934	15251	8317	1.20	2.20
Transplanting	7844	16587	8744	1.11	2.11
2018 season					
Broadcasting	6793	15149	8357	1.23	2.21
Dibbling	7568	16121	8553	1.14	2.14
Transplanting	8309	17815	9506	1.14	2.14

Table (4): Control and weed species susceptibility as affected by weed control treatments at 65 and 85 days after planting in 2017 and 2018 seasons.`

Weed control treatments	Rate fed^{-1}	Control % & weed species susceptibility						
		E.colonu	*D.retrofl*	*A.auricula*	*E.alba*	*C.diffor*	*C.rotund*	Total
		2017 season						
	65 DAP							
Saturn	1 L	81.0 MS	70.6 MT	51.6 T	14.4 T	83.8 MS	36.7 T	60.2 MT
Saturn	2 L	92.6 S	74.7 MT	53.9 T	19.3 T	86.7 MS	40.8 T	65.8 MT
Saturn + Basagran	1 L + 1.5	82.6 MS	71.5 MT	81.7 MS	81.4 MS	90.2 S	84.7 MS	82.3 MS
Saturn + Basagran	2 L + 1.5	93.1 S	75.6 MT	83.1 MS	83.2 MS	92.1 S	86.7 MS	86.5 MS
Saturn + Inpul	1 L +20 g	83.2 MS	71.9MT	84.9 MS	84.9 MS	91.1 S	89.8 MS	84.2 MS
Saturn + Inpul	2 L +20 g	93.7 S	76.9 MT	86.3 MS	86.0 MS	94.0 S	90.8 S	88.6 MS
Hand weeding	Twice	61.4 MT	80.5 MS	80.8 MS	76.5 MT	80.0 MS	76.5 MT	78.9 MS
Unweeded		0.0	0.0	0.0	0.0	0.0	0.0	0.0
	85 DAP							
Saturn	1 L	78.7 MT	49.3 T	33.3 T	18.5 T	76.1 MT	10.1 T	57.2 T
Saturn	2 L	89.4 MS	59.5 T	34.5 T	21.9 T	82.3 MS	16.0 T	64.6 MT
Saturn + Basagran	1 L + 1.5	80.8 MS	53.0 T	87.5 MS	85.1 MS	85.1 MS	81.2 MS	79.2 MT
Saturn + Basagran	2 L + 1.5	89.7 MS	64.2 MT	88.6 MS	87.4 MS	89.6 MS	85.7 MS	85.3 MS
Saturn + Inpul	1 L + 20 g	81.2 MS	54.2 T	87.8 MS	87.9 MS	86.5 MS	86.8 MS	80.5 MS
Saturn + Inpul	2 L + 20 g	90.5 S	65.0 MT	90.1 S	89.0 MS	90.8 S	87.8 MS	86.6 MS
Hand weeding	Twice	78.1 MT	79.0 MT	81.3 MS	77.2 MT	80.1 MS	78.4 MT	79.0 MT
Unweeded		0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2018 season 65 DAP							
Saturn	1 L	81.1 MS	69.0 MT	37.6 T	24.9 T	83.1 MS	40.0 T	60.3 MT
Saturn	2 L	91.8 S	76.7 MT	38.2 T	29.5 T	86.0 MS	43.2 T	66.1 MT
Saturn + Basagran	1 L + 1.5	82.3 MS	71.0 MT	82.4 MS	83.2 MS	89.5 MS	85.6 MS	82.6 MS
Saturn + Basagran	2 L + 1.5	90.9 S	78.4 MT	82.9 MS	84.7 MS	91.8 S	87.2 MS	87.3 MS
Saturn + Inpul	1 L + 20 g	83.5 MS	72.2 MT	82.4 MS	86.4 MS	90.4 MS	88.8 MS	84.2 MS
Saturn + Inpul	2 L + 20 g	93.2 S	79.2 MT	84.7 MS	88.2 MS	93.4 S	91.2 S	89.0 MS
Hand weeding	Twice	81.3 MS	81.2 MS	80.6 MS	79.2 MT	80.8 MS	81.6 MS	80.6 MS
Unweeded		0.0	0.0	0.0	0.0	0.0	0.0	0.0
	85 DAP							
Saturn	1 L	79.0 MT	50.2 T	37.0 T	21.7 T	77.1 MT	9.0 T	56.2 T
Saturn	2 L	89.2 MS	62.4 MT	38.9 T	25.7 T	82.2 MT	12.8 T	63.1 MT
Saturn + Basagran	1 L + 1.5	83.4 MS	53.1 T	87.5 MS	85.1 MS	86.1 MT	79.8 MS	81.0 MS
Saturn + Basagran	2 L + 1.5	89.8 MS	64.5 MT	88.1 MS	85.8 MS	89.6 MS	81.2 MS	90.9 S
Saturn + Inpul	1 L + 20 g	84.8 MS	55.1 T	87.5 MS	86.9 MS	87.0 MS	83.2 MS	82.3 MS
Saturn + Inpul	2 L + 20 g	90.0 MS	65.6 MT	89.1 MS	87.6 MS	90.8 S	83.7 MS	86.4 MS
Hand weeding	Twice	82.3 MS	78.3 MT	81.1 MS	77.9 MT	80.9 MS	68.4 MT	80.1 MS
Unweeded		0.0	0.0	0.0	0.0	0.0	0.0	0.0

S = > 90 % control Susceptible | MS = > 80-90 % Moderately | MT = >60-79 % control Moderately Tolerant | T = <60 % control Tolerant

Basagran 1.5 l fed^{-1}) gave 88.6 and 86.5 % in 2017 season, respectively, as compared to unweeded check without significant differences between them. These results had the same trend at second survey and second season this mean Saturn + Inpul or with Basagran had control spectrum weed total weeds than the use of single herbicides. These results are in agreement with those obtained by Zhang *et al.*, (2005).

3.2.2. Dry weight of weeds

Data in Table (5) show that the dry weight of total weeds was significantly affected by all weed control treatments in both planting seasons. In the first season at 65 days after planting (DAP), weed control treatments could be arranged descending based of dry weight for grassy weeds (*E. colonum*) and (*D. retroflexa*) : (Saturn 2 l fed^{-1} + Inpul 20 g fed^{-1}) by (93.6 and 77.1%), (Saturn 2l fed^{-1}+ Basagran 1.5 l fed^{-1}) by (93.1 and 75.7 %), (Saturn 2l fed^{-1} alone) by (92.6 and 75.2%) and hand weeding twice by (78.5 and 80.7%) as compared to the unweeded check, respectively. While broad-leave weeds (*A. auriculata*) and (*E. alba*): (Saturn 2l fed^{-1}+ Inpul 20 g fed^{-1}) by (86.5 and 86.0%), (Saturn 2 l fed^{-1}+ Basagran 1.5 l fed^{-1}) by (83.0 and 83.2 %), (Saturn 2l fed^{-1}alone) by (54.0 and 19.6%) and hand weeding twice by (80.8 and 76.4 %) as

Table (5): Effect of weed control treatments on dry weight of weeds (g m^{-2}) at 65 and 85 days after planting in 2018 season.

Weed control	Rate fed^{-1}	Dry weight of weeds (g m^{-2})						
		E.colonummm	*D.retroflexa*	*A.auriculata*	*E.alba*	*C.differmis*	*C.rotundus*	Total weeds
		season 2017						
65 Dap								
Saturn	1 L	6.9	6.5	10.6	24.4	5.1	6.2	59.7
Saturn	2 L	2.7	5.6	10.1	23.0	4.2	5.8	51.3
Saturn + Basagran	1 L +	6.3	6.3	4.0	5.3	3.1	1.5	26.5
Saturn + Basagran	2 L +	2.5	5.4	3.7	4.8	2.5	1.3	20.2
Saturn + Inpul	1 L +20	6.1	6.2	3.3	4.3	2.8	1.0	23.7
Saturn + Inpul	2 L +20	2.3	5.1	3.0	4.0	1.9	0.9	17.1
Hand weeding	Twice	7.8	4.3	4.2	6.7	6.3	2.3	31.6
Unweeded check		36.3	22.1	21.9	28.5	31.5	9.8	150.1
LSD 0.05		1.36	1.15	1.28	1.30	1.22	0.64	6.31
85 Dap								
Saturn	1 L	41.8	42.6	44.3	66.6	32.4	25.8	253.5
Saturn	2 L	20.7	34.0	43.5	63. 8	24.0	24.1	210.0
Saturn + Basagran	1 L +	37.7	39.5	8.3	12.2	20.2	5.4	123.3
Saturn + Basagran	2 L +	20.2	30.1	7.6	10.3	14.1	4.1	87.0
Saturn + Inpul	1 L +20	36.9	38.5	8.1	9.9	18.3	3.8	115.6
Saturn + Inpul	2 L +20	18.6	29.4	6.6	9.0	12.5	3.5	79.6
Hand weeding	Twice	43.0	17.6	12.4	18.6	27.0	6.2	124.7
Unweeded check		195.9	84.0	66.4	81.7	135.7	28.7	592.5
LSD 0.05		11.53	3.82	4.55	6.16	8.11	2.19	33.35
Season 2018								
65 Dap								
Saturn	1 L	7.9	7.6	10. 6	26.0	5.8	7.5	65.4
Saturn	2 L	3.4	5. 7	10.5	24.4	4.8	7.1	55.9
Saturn + Basagran	1 L +	7.4	7.1	3.0	5.8	3.6	1.8	28.7
Saturn + Basagran	2 L +	3. 8	5.3	2.9	5.3	2.8	1.6	20.9
Saturn + Inpul	1 L +20	6.9	6. 8	3.0	4. 7	3.3	1.4	26.0
Saturn + Inpul	2 L +20	2.8	5.1	2.6	4.1	2.3	1.1	18.1
Hand weeding	Twice	7.8	4.6	3.3	7.2	6.6	2.3	31.9
Unweeded check		41.8	24.5	17.0	34.6	34.3	12.5	164.8
LSD 0.05		2.02	1.14	0.95	2.08	1.67	0.72	7.62
85 Dap								
Saturn	1 L	38. 9	34.4	40.3	80.3	29.8	33.4	257.1
Saturn	2 L	20.0	26.0	39.1	76.2	23.2	32.0	216.6
Saturn + Basagran	1 L +	30.7	32.4	8.0	15.3	18.1	7.4	111.9
Saturn + Basagran	2 L +	18.9	24.5	7.6	14.5	13.5	6.9	85.9
Saturn + Inpul	1 L +20	28.1	31.0	8.0	13.4	16.9	6.4	103.8
Saturn + Inpul	2 L +20	18.5	23.8	7.0	12.7	12.0	6.0	80.1
Hand weeding	Twice	32.8	15.0	12.1	22.7	24.8	11.6	117.1
Unweeded check		185.1	69.1	64.0	102.6	130.0	36.7	587. 5
LSD 0.05		6.79	3.16	3.67	6.47	6.21	2.38	25.37

compared to the unweeded check, respectively. Also, Sedges weeds, (*C. differmis*) and (*C. rotundus*)): (Saturn 2 l fed^{-1}+ Inpul 20 g fed^{-1}) by (93.9 and 90.8%), (Saturn 2l fed^{-1} + Basagran 1.5 l fed^{-1}) by (92.18 and 87.0 %), (Saturn 2L fed^{-1} alone) by (86.6 and 40.9%) and hand weeding twice by (80.1 and 76.9%) as compared to the unweeded check, respectively. The second survey and the second season had the same trend .

Dry weight of total weeds is significantly affected by (Saturn 2 l fed^{-1} + Inpul 20 g fed^{-1} by 88.6 %), (Saturn 2 l fed^{-1} + Basagran 1.5 L fed^{-1}, by 86.5 %), (Saturn 1 l fed^{-1} + Inpul 20 g fed^{-1}, by 84.2%),(Saturn 1 l fed^{-1} +Basagran 1.5 l fed^{-1}, by 82.4 %) and (hand weeding twice by 79.0 %) as compared to the unweeded check, at 65 DAP in the first season, respectively. This result had the same trend in second survey at 85 DAP, and second season. The high efficacy this herbicide combination are attributed to broaden

weed control spectrum exited weed species either grasses, sedges and exceeded broad-leaved weeds alternative. Similar results were obtained by Tagour *et al.* (2016) and Ghalwash *et al.* (2019).

3.2.3. Yield and its components

Weed control treatments had a substantial significant increasing effect on rice grain yield and its components i.e., plant height, panicle length, number of panicle m^{-2}, number of full grain $panicle^{-1}$, 1000-grain weight, straw and grain yield ton fed^{-1} as compared with un-weeded check in both growing seasons. Data in Table (6) show that, weed control treatments, (Saturn at 2 l fed^{-1} + Basagran at 1.5 l fed^{-1}), (Saturn at 2 l fed^{-1} + Inpul at 20g fed^{-1}), (Saturn at 1 l fed^{-1} + Inpul at 20 g fed^{-1}),(Saturn at 1 l fed^{-1}+ Basagran1.5 l fed^{-1}),(Saturn at 2 l fed^{-1}), (Saturn at 1 l fed^{-1}) and hand weeding twice increased grain yield of rice as ton fed^{-1} estimated by, 51.1, 51.0, 40.3, 40.2 37.0, 29.0 and 33.4 % respectively, in the first season; and by 52.6, 52.9, 42.0, 41.5, 38.7, 31.4 and 35.6 % respectively, in the second season as compared with unweeded check. Similar results were in agreement with Ghalwash *et al.* (2019) and showed that single herbicides or their combination succeeded to increase grain yield by application Saturn 2l fed^{-1} + Inpul 20 g fed^{-1}, Saturn 2l + Basagran 1.5 l fed^{-1} and hand weeding twice by 43.97, 59.1and 30.2 %, respectively.

3.2.4. Economic feasibility

Data in Table (7) show that the all studied economic criteria was affected by herbicidal treatments and exceeded hand weeding twice. The highest net income (LE fed^{-1}) was obtained by (Saturn 2 l fed^{-1} + Inpul 20g fed^{-1}) which gave 12343 and 13307 (LE fed^{-1}) followed by (Saturn 2 l fed^{-1} + Basagran 1.5 l fed^{-1}) which gave 12204 and 13112 (LE fed^{-1}) in both seasons, respectively. The highest net income was obtained from herbicidal combinations treatments more than, hand weeding twice and unweeded check during, 2017 and 2018 seasons. The increases of partial costs were obtained with hand weeding twice where reached to 6629 and 7099 LE fed^{-1} in the 2017 and the 2018, respectively, while it was obtained reduced to (2698 and 2797 LE fed^{-1}) with unweeded check in both seasons, respectively. Similar results were in agreement with Jagtap *et al.* (2018) and Ghalwash *et al.* (2019).

Table (6): Effect of weed control treatments on grain yield and its components in 2017 and 2018 seasons.

Weed control treatments	Rate fed^{-1}	Plant height (cm)	Panicle length (cm)	No. Panicles m^{-2}	No. full grain $panicle^{-1}$	1000 grain weight (g)	Straw yield ton fed^{-1}	Grain yield ton fed^{-1}
Season 2017								
Saturn	1 L	85.6	23.8	298.8	116.3	22.66	4.13	3.03
Saturn	2 L	88.3	24.6	322.7	134.3	23.03	4.57	3.37
Saturn+ Basagran	1 L + 1.5 L	95.1	25.1	337.3	142.7	23.46	4.92	3.56
Saturn+ Basagran	2 L + 1.5 L	107.4	26.1	353.5	162.0	25.86	5.72	4.36
Saturn+ Inpul	1 L +20 g	96.5	25.2	338.5	143.2	23.47	4.93	3.57
Saturn+ Inpul	2 L +20 g	109.7	26.2	354.8	162.0	25.89	5.75	4.35
Hand weeding	Twice	89.1	24.6	309.3	128.3	23.31	4.31	3.20
Unweeded check		77.8	20.9	215.3	96.3	20.94	3.06	2.13
L S D $_{0.05}$		2.45	0.38	10.15	5.05	0.37	0.21	0.15
Season 2018								
Saturn	1 L	83.3	23.4	293.4	114.2	22.62	4.07	2.96
Saturn	2 L	86.2	24.2	317.7	132.2	22.99	4.50	3.31
Saturn+ Basagran	1 L + 1.5 L	92.9	24.7	331.2	140.3	23.43	4.83	3.47
Saturn+ Basagran	2 L + 1.5 L	106.2	25.7	347.8	159.3	25.82	5.61	4.28
Saturn+ Inpul	1 L +20 g	93.6	24.8	333.3	140.8	23.44	4.84	3.50
Saturn+ Inpul	2 L +20 g	107.6	25.7	348.9	160.0	25.84	5.64	4.31
Hand weeding	Twice	87.1	24.2	300.6	126.2	23.28	4.23	3.15
Unweeded check		76.0	20.0	219.4	94.58	20.58	2.83	2.03
L S D $_{0.05}$		2.75	0.47	10.69	4.32	0.34	0.20	0.17

Table (7): Effect of weed control treatments on economic analysis of rice crop during 20l7 and 2018 seasons.

Herbicidal rates fed^{-1}	Total cost LE fed.$^{-1}$	Gross income LE fed.$^{-1}$	Net income LE fed.$^{-1}$	Profitability	Benefit / Costs Ratio
2018 season					
Saturn at 1 L	6840	13553	6713	0.99	1.97
Saturn at 2 L	6930	15046	8116	1.18	2.20
Saturn at 1L+ Basagran at 1.5 L	7030	15793	8763	1.25	2.27
Saturn at 2L + Basagran at 1.5 L	7120	19324	12204	1.73	2.70
Saturn at 1L+ Inpul at 20 g	7010	15867	8857	1.27	2.30
Saturn at 2L + Inpul at 20 g	7100	19443	12343	1.75	2.77
Hand weeding twice	7667	14296	6629	0.87	1.87
Unweeded check	6767	9464	2698	0.38	1.37
2018 season					
Saturn at 1 L	7212	14364	7153	1.00	1.97
Saturn at 2 L	7998	16053	8055	1.04	2.03
Saturn at 1L+ Basagran at 1.5 L	7475	16825	9350	1.26	2.23
Saturn at 2L + Basagran at 1.5 L	7595	20707	13112	1.74	2.73
Saturn at 1L+ Inpul at 20 g	7425	16996	9571	1.30	2.30
Saturn at 2L + Inpul at 20 g	7545	20852	13307	1.78	2.77
Hand weeding twice	8160	15259	7099	0.87	1.87
Unweeded check	7040	9837	2797	0.38	1.40

3.3. Effect of interaction between planting methods and weed control treatments

3.3.1. Dry weight of weeds (gm^{-2})

All data concerned with the effect of interaction between rice planting methods with weed control treatments did not differ significantly at 5 % level on the dry weight of *(Dinebra retroflexa, Ammannia auriculata,* and *Cyperus rotundus*) at 65 and 85 DAP in 2017and 2018 seasons, with meaning that the two studied factors act independent and their data were excluded, meanwhile the effect of interaction on, (*Eclipta alba, and Cyperus difformis)* and total weeds at 65 and 85 DAP in the two seasons arrived to significant at 5 % level, expect *(Echinochloa colonum*) not significant in 85 DAP in season 2017. (Table 8). The high efficiency of these herbicides' combinations against weeds in rice was attributed to widening weeds control spectrum by Saturn against (*Echinochloa colonum*, *Dinebra retroflexa* and *Cyperus difformis*) plus Basagran or Inpul against sedges weeds or broad-leaved weeds. The best interaction between planting methods (transplanting and dibbling) with combination for weed control (Saturn 2.0 l fed^{-1} + Inpul 20 g fed^{-1}), (Saturn 2.0 l fed^{-1} + Basagran 1.5 l fed^{-1}) which decreased the dry weight of total weeds by 92.6 and 89.6 % at 65 DAP, as compared to unweeded check of broadcast. The results had the same trend in the second survey at 85DAP and second season. Similar results were obtained by Mousa and Noreldin (2015) reported that herbicide active on annual grasses and broadleaf weeds and noticed that had a broad spectrum on controlling broadleaf weeds with some activity on sedges and grass weeds. Also, these results agree with those obtained by Ghalwash *et al.* (2019).

3.3.2. Yield and its components

Data in Table (9) showed that the effect of interactions between rice planting methods and weed control treatments was statistically significantly at 5 % level on grain yield ton fed^{-1}, panicle length (cm) and number of panicles m^{-2} in 2017 season, panicle length (cm), number of panicles m^{-2}, 1000- grain weight, straw and grain yield ton fed^{-1} 20018 season.

Concerning the effect of the interaction on grain yield ton fed^{-1} the results show that under unweeded check condition transplanting and dibbling method increase significantly rice grain

Table (8): Effect of the interaction between planting methods and weed control treatments on dry weight of weeds (gm^{-2}) at 65 and 85 days after planting in 2017 and 2018 seasons.

Planting methods	Weed control	Rate fed^{-1}	Dry weight of weeds gm^{-1}						
			65 DAP				85 DAP		
			E.colonu	*E.alba*	*C.differmis*	Total	*E.alba*	*C.differmis*	Total
			2017 season						
Broadcasting	Saturn	1 L	8.2	28.8	6.6	69.9	82.4	40.2	300.4
	Saturn	2 L	3.3	26.7	5.7	59.5	75.9	29.8	241.5
	Saturn+pasagran	1 L + 1.5 L	7.8	7.1	3.9	32.1	17.1	24.6	150.4
	Saturn+ pasagran	2 L + 1.5 L	2.9	6.6	3.2	24.4	14.0	17.2	105.0
	Saturn+ Inpul	1 L +20 g	7.8	5.7	3.3	28.5	13.3	21.4	139.0
	Saturn+ Inpul	2 L +20 g	2.9	5.4	2.4	20.8	12.6	15.6	97.5
	Hand weeding	Twice	9.8	10.8	8.4	43.0	30.9	36.6	179.0
	unweeded check		39.9	35.2	38.0	172.6	107.3	159.5	682.0
Dibbling	Saturn	1 L	6.8	25.6	5.4	61.9	70.6	36.0	260.0
	Saturn	2 L	3.0	25.0	4.5	55.1	68.7	26.6	220.9
	Saturn+pasagran	1 L + 1.5 L	6.4	5.1	3.3	26.8	11.8	22.5	125.7
	Saturn+ pasagran	2 L + 1.5 L	2.8	4.5	2.7	20.6	10.0	15.7	91.9
	Saturn+ Inpul	1 L +20 g	6.2	4.2	3.0	24.4	10.3	20.4	120.0
	Saturn+ Inpul	2 L +20 g	2.4	4.1	2.0	17.8	8.9	14.1	85.2
	Hand weeding	Twice	7.3	5.8	6.2	29.2	15.2	27.7	113.2
	Unweeded check		35.7	29.1	33.5	153.0	80.8	149.7	613.7
Transplanting	Saturn	1 L	5.6	18.8	3.3	47.2	40.2	20.9	200.2
	Saturn	2 L	1.8	17.2	2.4	39.3	39.2	15.7	167.6
	Saturn+ pasagran	1 L + 1.5 L	4.7	3.7	2.1	20.5	6.6	13.6	93.8
	Saturn+ pasagran	2 L + 1.5 L	1.8	3.3	1.5	15.5	5.9	9.4	64.0
	Saturn+ Inpul	1 L +20 g	4.5	2.9	2.1	18.3	6.6	13.1	87.7
	Saturn+ Inpul	2 L +20 g	1.6	2.5	1.4	12.7	5.1	7.8	56.0
	Hand weeding	Twice	6.5	3.7	4.2	22.6	9.7	16.7	81.9
	Un-weedy check		33.4	21.3	22.9	124.9	54.7	98.0	481.7
LSD 0.05			4.72	4.44	4.21	37.8	21.33	28.11	97.01

			2018 season							
			65 DAP				85 DAP			
			E.colonu	*E.alba*	*C.differmis*	Total	*E.colonum*	*E. alba*	*C.diffo*	Tot
Broadcasting	Saturn	1 L	9.4	31.1	7.5	76.6	47.2	93.8	37.9	296.9
	Saturn	2 L	4.1	28.8	6.2	65.5	24.2	86.8	28.5	245.1
	Saturn+ pasagran	1 L + 1.5 L	8.8	7.5	4.3	34.2	34.4	18.9	21.3	128.3
	Saturn+ pasagran	2 L + 1.5 L	3.5	7.1	3.5	25.4	21.8	18.3	16.5	100.8
	Saturn+ Inpul	1 L +20 g	8.6	6.4	4.1	31.6	30.9	16.3	20.1	117.1
	Saturn+ Inpul	2 L +20 g	3.3	5.6	3.0	21.8	22.4	16.2	15.1	94.4
	Hand weeding	Twice	9.6	11.0	8.8	42.6	40.3	36.5	33.5	159.3
	unweeded check		46.9	41.2	40.9	188.5	198.8	124.6	151.8	661.2
Dibbling	Saturn	1 L	7.8	27.6	6.2	68.2	41.3	85.9	34.2	271.7
	Saturn	2 L	3.7	26.0	5.1	58.7	23.0	82.3	25.4	231.0
	Saturn+ pasagran	1 L + 1.5 L	7. 5	5.6	3.8	29.4	32.2	15.1	20.1	117.1
	Saturn+ pasagran	2 L + 1.5 L	3.3	4.8	3.0	21.6	21.8	14.1	15.2	91.3
	Saturn+ Inpul	1 L +20 g	7.0	4.4	3.5	26.8	29.8	13.2	18.7	109.6
	Saturn+ Inpul	2 L +20 g	3.1	4.0	2.4	18.7	21.2	12.8	13.8	86.4
	Hand weeding	Twice	7.6	6.3	6.6	30.1	31.6	19.2	25.7	113.1
	Unweeded check		43.2	37.4	36.9	172.5	191.6	108.1	145.6	619.4
Transplanting	Saturn	1 L	6.5	19.3	3.7	51.4	28.2	61.0	17.4	202.8
	Saturn	2 L	2.5	18.4	3.2	43.4	13.0	59.4	15.6	173.7
	Saturn+ pasagran	1 L + 1.5 L	5.9	4.4	2.7	22.5	25.4	12.0	12.9	90.2
	Saturn+ pasagran	2 L + 1.5 L	2.5	4.0	1.7	15.8	13.0	11.3	8.9	65.7
	Saturn+ Inpul	1 L +20 g	5.2	3.3	2.4	19.8	23.6	10.76	12.03	84.6
	Saturn+ Inpul	2 L +20 g	2.1	2.8	1.6	13.8	12.0	9.03	7.14	59.4
	Hand weeding	Twice	6.3	4.3	4.4	22.9	26.6	12.36	15.15	84.7
	unweeded check		35.4	25.4	25.2	133.4	164.9	75.09	92.54	481.8
LSD 0.05			7.00	7.20	5.77	26.40	23.52	22.43	21.49	87.88

Table (9): Effect of the interaction between sowing methods and weed control treatments on yield and its components in 2017 and 2018 seasons.

Planting Methods	Weed control treatments	Rate fed^{-1}	2017 season			2018 season				
			Panicle length (cm)	No. Panicles m^{-2}	Grain yield ton fed^{-1}	Panicle length (cm)	No. Panicles m^{-2}	1000 grain weigh t (g)	Straw yield ton fed^{-1}	Grain yield ton fed^{-1}
Broadcasting	**Saturn**	1 L	23.3	283.3	2.79	22.9	278.0	22.21	3.87	2.73
	Saturn	2 L	24.1	305.8	3.15	23.8	300.8	22.67	4.29	3.18
	Saturn+ Basagran	1 L + 1.5 L	24.7	319.5	3.34	24.3	312.5	23.04	4.64	3.25
	Saturn+ Basagran	2 L + 1.5 L	25.8	334.0	4.14	25.4	328.5	25.42	5.36	4.09
	Saturn+ Inpul	1 L +20 g	24.7	320.0	3.36	24.3	317.8	23.06	4.65	3.27
	Saturn+ Inpul	2 L +20 g	25.8	334.8	4.16	25.4	329.3	25.43	5.38	4.13
	Hand weeding	Twice	24.1	294.5	3.03	23.8	280.0	23.03	3.99	2.98
	Unweeded check		20.3	202.8	1.49	18.2	214.3	19.64	2.06	1.37
Dibbling	**Saturn**	1 L	23.7	300.8	2.99	23.3	296.0	22.47	4.06	2.91
	Saturn	2 L	24.6	326.8	3.30	24.2	321.8	22.86	4.48	3.16
	Saturn+ Basagran	1 L + 1.5 L	25.3	340.5	3.45	24.9	335.5	23.37	4.79	3.39
	Saturn+ Basagran	2 L + 1.5 L	26.2	359.0	4.29	25.8	353.0	25.58	5.55	4.21
	Saturn+ Inpul	1 L +20 g	25.3	341.0	3.47	24.87	336.0	23.38	4.80	3.45
	Saturn+ Inpul	2 L +20 g	26.2	360.8	4.32	25.8	354.8	25.63	5.59	4.23
	Hand weeding	Twice	24.9	314.0	3.18	24.5	309.0	23.23	4.24	3.11
	Unweeded check		21.0	217.8	2.30	20.8	224.0	20.93	3.15	2.15
Transplanting	**Saturn**	1 L	24.3	312.5	3.32	23.9	306.3	23.19	4.27	3.25
	Saturn	2 L	25.0	335.5	3.65	24.6	330.5	23.46	4.72	3.60
	Saturn+ Basagran	1 L + 1.5 L	25.5	352.0	3.81	25.1	345.5	23.87	5.06	3.77
	Saturn+ Basagran	2 L + 1.5 L	26.4	367.5	4.55	26.0	361.8	26.47	5.91	4.53
	Saturn+ Inpul	1 L + 20 g	25.5	354.5	3.82	25.1	346.0	23.88	5.08	3.80
	Saturn+ Inpul	2 L + 20 g	26.4	368.8	4.58	26.0	362.8	26.47	5.95	4.56
	Hand weeding	Twice	24.9	319.3	3.39	24.5	312.8	23.57	4.47	3.36
	Unweeded check		21.3	225.3	2.59	21.1	220.0	21.16	3.29	2.56
LSD			1.31	55.15	0.65	1.62	37.02	1.16	1.04	0.96

yield (42.5 and 35.2%) and (46.5 and 36.3 %) than unweeded check broadcasting in 2017 and 2018 seasons respectively, whereas rice grain yield under (Saturn 2 l fed^{-1} + Inpul 20 g fed^{-1}) was gave (67.5, 65.5 and 64.2 %) and Saturn 2 l fed^{-1} + Basagran 1.5 l fed^{-1} (67.3, 65.5 and 64.2%) under transplanting, dibbling and broadcasting methods without significant differences between the three methods in 2017 season. But (Saturn 1 l fed^{-1} + Inpul 20 g fed^{-1}) and (Saturn 1 L fed^{-1} + Basagran 1.5 L fed^{-1}) and hand weeding twice, gave grain yield (61.0, 57.1 and 56.1 %), (60.9, 56.8 and 53.1 %) and (56.1, 53.1 and 50.8 %). These results show that weed stress was lower on rice yield under transplanting or dibbling methods than unweeded check condition of broadcasting method. Meanwhile the gap in the yield was diminished under the three rice planting methods due to the elimination of weed competition by these herbicide combinations, thus, expanding in planting rice by broadcasting method and avoid the problem of well-trained Labor and their high cost when growing rice by broadcasting method. Similar results were found by Maity and Mukhherjee (2008), Singh *et al.* (2009) and Ghalwash *et al.* (2019).

Regarding the number of panicle m^{-2}, the highest weight for produced the number of panicle m^{-2} when weeds were controlled by Saturn 2 l fed^{-1} + Inpul 20 g fed^{-1} and Saturn 2 l

Table (10): Effect of the interaction between sowing methods and weed control treatments on economic analysis of rice crop during 20l7 and 2018 seasons.

Planting Methods	Weed control treatments	2017 season					2018 season				
		Total cost LE fed.$^{-1}$	Gross income LE fed.$^{-1}$	Net income LE fed.$^{-1}$	Profitability	Benefit / Costs Ratio	Total cost LE fed.$^{-1}$	Gross income LE fed.$^{-1}$	Net income LE fed.$^{-1}$	Profitability	Benefit /Costs Ratio
Broadcasting	Saturn at 1 L / fed.	6125	12473	6348	1.04	2.0	6460	13238	6778	1.05	2.0
	Saturn at 2 L / fed.	6215	14078	7863	1.27	2.3	6580	15405	8825	1.34	2.3
	Saturn at 1L + Basagran at 1.5 L / fed.	6305	14932	8627	1.37	2.4	6725	15774	9049	1.35	2.3
	Saturn at 2L + Basagran at 1.5 L / fed.	6395	18490	12095	1.89	2.9	6845	19803	12958	1.89	2.9
	Saturn at 1L + Inpul at 20 g / fed.	6285	15021	8736	1.39	2.4	6675	15858	9183	1.38	2.4
	Saturn at 2L + Inpul 20 g / fed.	6375	18579	12204	1.91	2.9	6795	19994	13199	1.94	2.9
	Hand weeding twice	7485	13535	6050	0.81	1.8	7970	14434	6464	0.81	1.8
	Unweeded check	5985	6539	554	0.09	1.1	6290	6689	399	0.06	1.1
Dibbling	Saturn at 1 L / fed.	6725	13362	6637	0.99	2.0	7090	14107	7017	0.99	2.0
	Saturn at 2 L / fed.	6815	14759	7944	1.17	2.2	7435	15324	7889	1.06	2.1
	Saturn at 1L + Basagran at 1.5 L / fed.	6905	15424	8519	1.23	2.2	7355	16438	9083	1.24	2.2
	Saturn at 2L + Basagran at 1.5 L / fed.	6995	19159	12164	1.74	2.7	7475	20386	12911	1.73	2.7
	Saturn at 1L + Inpul at 20 g / fed.	6885	15513	8628	1.25	2.3	7305	16724	9419	1.29	2.3
	Saturn at 2L + Inpul 20 g / fed.	6975	19293	12318	1.77	2.8	7425	20484	13059	1.76	2.8
	Hand weeding twice	7385	14208	6823	0.92	1.9	7760	15069	7309	0.94	1.9
	Unweeded check	6785	10291	3506	0.52	1.5	6920	10433	3513	0.51	1.5
Transplanting	Saturn at 1 L / fed.	7670	14825	7155	0.93	1.9	8085	15748	7663	0.95	1.9
	Saturn at 2 L / fed.	7760	16300	8540	1.10	2.1	8205	17430	9225	1.12	2.1
	Saturn at 1L / fed. + Basagran at 1.5 L / fed.	7880	17022	9142	1.16	2.2	8345	18262	9917	1.19	2.2
	Saturn at 2L/fed. + Basagran at 1.5 L / fed.	7970	20322	12352	1.55	2.5	8465	21931	13466	1.59	2.6
	Saturn at 1L / fed. + Inpul at 20 g / fed.	7860	17067	9207	1.17	2.2	8295	18406	10111	1.22	2.2
	Saturn at 2L / fed. + Inpul 20 g / fed.	7950	20456	12506	1.57	2.6	8415	22077	13662	1.62	2.6
	Hand weeding twice	8130	15144	7014	0.86	1.9	8750	16273	7523	0.86	1.9
	Unweeded check	7530	11563	4033	0.54	1.5	7910	12390	4480	0.57	1.6

Table (11): Correlation coefficient between all studied characters analysis between weeds, rice yield and its components in 2017 and 2018 seasons.

Characters	*D. retroflexa*	*A. auriculata*	*E. alba*	*C. difformis*	*C. rotundus*	Total weeds	plant height (cm)	Panicle length (cm)	No. panicle m^{-2}	No. of full grain $panicle^{-1}$	1000-grain weight (g)	Straw yield (ton fed^{-1})	Grain yield (ton fed^{-1})
						2017 season							
E. colonu	0.955**	0.605**	0.857**	0.977**	0.751**	0.933**	-0.212*	-0.116	-0.393*	-0.369*	-0.114	-0.440**	-0.489**
D. retroflexa		0.641**	0.902**	0.947**	0.789**	0.940**	-0.019	-0.022	-0.214*	-0.189	-0.075	-0.252*	-0.308*
A. auriculata			0.895**	0.676**	0.952**	0.842**	-0.230*	-0.095	-0.287*	-0.371*	-0.080	-0.392*	-0.449**
E. alba				0.895**	0.968**	0.981**	-0.122	-0.022	-0.260*	-0.286*	-0.014	-0.342*	-0.398*
C. difformis					0.788**	0.937**	-0.222*	-0.168	-0.400*	-0.377*	-0.116	-0.446**	-0.498**
C. rotundus						0.926**	-0.155	-0.028	-0.255*	-0309*	-0.003	-0.354*	-0.401**
Total weeds							-0.192	-0.104	-0.346*	-0.360*	-0.062	-0.418**	-0.476**
plant height (cm)								0.972**	0.964**	0.960**	0.982**	0.964**	0.930**
Panicle length (cm)									0.962**	0.915**	0.993**	0.914**	0.864**
No. panicle m^{-2}										0.970**	0.946**	0.974**	0.941**
No. of full grain $panicle^{-1}$											0.917**	0.982**	0.969**
1000-grain weight (g)												0.914**	0.869**
Straw yield (ton/fed)													0.984**
						2018 season							
E. colonum	0.978**	0.776**	0.682**	0.979**	0.779**	0.940**	-0.256*	-0.241*	-0.386*	-0.460**	-0.241*	-0.452**	-0.509**
D. retroflexa		0.816**	0.719**	0.954**	0.815**	0.948**	-0.231*	-0.226*	-0.362*	-0.429**	-0.222*	-0.339*	-0.399*
A. auriculata			0.969**	0.809**	0.987**	0.938**	-0.296*	-0.224*	-0.356*	-0.492**	-0.244*	-0.383*	-0.435**
E. alba				0.743**	0.969**	0.889**	-0.306*	-0.215*	-0.345*	-0.502**	-0.243*	-0.391*	-0.444**
C. difformis					0.806**	0.957**	-0.259*	-0.244*	-0.387*	-0.465**	-0.239*	-0.466**	-0.521**
C. rotundus						0.938**	-0.305*	-0.225*	-0.370*	-0.503**	-0.249*	-0.410**	-0.456**
Total weeds							-0.293*	-0.247*	-0.396*	-0.509**	-0.257*	-0.446**	-0.504**
plant height (cm)								0.974**	0.973**	0.936**	0.980**	0.962**	0.941**
Panicle length (cm)									0.975**	0.884**	0.990**	0.913**	0.885**
No. panicle m^{-2}										0.949**	0.972**	0.967**	0.932**
No. of full grain $panicle^{-1}$											0.909**	0.992**	0.974**
1000-grain weight (g)												0.910**	0.896**
Straw yield (ton/fed)													0.992**

fed^{-1} + Basagran 1.5 l fed^{-1} in two seasons compared to the unweeded check.

All the applied herbicide treatments showed great increases in rice grain yield as compared to the unweeded check plots in both seasons, because herbicides combination can control most of grassy, broadleaf and sedges weeds. Similar findings were reported by Tagour *et al.* (2016) and Ghalwash *et al.* (2019).

3.3.3. Economic feasibility

Data in Table (10) show that profitability were increased broadcasting and dibbling methods with (Saturn 2 l fed^{-1} + Inpul 20g fed^{-1}) and (Saturn 2 l fed^{-1} + Basagran 1.5 l fed^{-1}) by (1.91 and 1.89) and (1.77 and 1.74) and (1.94 and 1.89) and (1.76 and 1.73) as compared with transplanting method by (1.57 and 1.55) and (1.62 and 1.59), respectively, in the first and second seasons.

On the other hand, the results of the interactions between planting methods and herbicides treatments on gross income, net income and profitability were fluctuated but are still superior than hand weeding twice and less than obtained with broadcasting and dibbling methods in both seasons. These results are in agreement with those obtained by Ghalwash *et al.* (2019) cited that Economic feasibility study of various weed management package results referred clearly that under Kafrelshiekh condition (Sunil *et al*., 2002 and Mamun *et al*., 2013)

3.4.Correlation between all studied characters and rice grain yield

Data presented in Table (11) indicated clearly that simple correlation coefficients between dry weight of grassy weeds *(Echinochloa colonum*. and *Dinebra retroflexa*), broad-leave weeds species *(Ammannia auriculata*, and *Eclipta alba*), sedges weeds *(Cyperus difformis* and *Cyperus rotundus)*, and rice grain yield were statistically significant and negative at 5% level. Such correlation was strong with *(Cyperus difformis, Echinochloa colonu*, *Eclipta alba*) and total weeds (-0.498, -0.489, -0.449 and -0.476) and (-0.521, -0.509, -0.444 and -0.504) than with (*Dinebra retroflexa*, *Ammannia auriculata* and *Cyperus rotundus*) (-0.308, -0.398 and -0.401) and (-0.399, -0.435 and -0.456) for the two seasons respectively. All studied characters and rice grain yield were negatively and highly significantly correlated with number of panicle m^{-2}, number of full grain panicle^{-1}, straw yield and grain yield (ton fed^{-1}) in both seasons. While, all studied characters of weeds did not significantly on the plant height, panicle length and 1000-grain weight with in the first seasons. Grain yield (ton fed^{-1}) was positively and highly significantly correlated with plant height, panicle length, number of panicle m^{-2}, number of full grain panicle^{-1}, 1000-grain weight and straw yield (ton fed^{-1}) in both seasons, suggesting that rice grain yield can be affected strongly by weeds competition, and need suitable control program for these weed species to increase rice productivity per unit area.

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تأثير طرق الزراعة وبعض مبيدات الحشائش علي الحشائش وإنتاجية محصول الارز

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ملخص

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بالجميزة – محافظة الغربية – مصر ، خلال موسمي الزراعة 2017 و 2018 بهدف دراسة تأثير ثلاث طرق لزراعة الارز هي (الشتل ، اللقمه و البدار) وثمانية معاملات لمكافحة الحشائش هي (ساتيرن 50% بمعدل 1 لترفدان$^{-1}$ ، ساتيرن 50 % بمعدل 2 لترفدان $^{-1}$ ، ساتيرن 50% بمعدل 1 لترفدان$^{-1}$ + بازجران 48 % بمعدل 1.5 لتر فدان$^{-1}$ ، ساتيرن 50 % بمعدل 2 لترفدان $^{-1}$+ بازجران 48 % بمعدل 1.5 لتر فدان$^{-1}$ ، ساتيرن 50% بمعدل 1 لترفدان$^{-1}$ + انبول 75 % بمعدل 20 جم فدان$^{-1}$ ، ساتيرن 50 % بمعدل 2 لترفدان $^{-1}$+ انبول 75 % بمعدل 20 جم فدان$^{-1}$ ، النقاوة اليدويه مرتين بالاضافه الي بدون معاملة) والتفاعل بينهم علي حساسية بعض انواع الحشائش لتوليفات مبيدات الحشائش المستخدمة وانتاجية محصول الارز. استخدم تصميم القطع المنشقه مرة واحدة مع اربع مكررات حيث وزعت طرق الزراعة في القطع الرئيسية ومعاملات مكافحة الحشائش في القطع الشقيه.

أوضحت النتائج ان استخدام طريقتي الزراعة بالشتل واللقمة ادت الي نقص الوزن الجاف للحشائش الكلية عند 65 يوم من الزراعة بنسبة (33.4 و13.8 %) و (33.6 و12.5 %) خلال موسمي الزراعة علي التوالي مقارنة بطريقة الزراعة البدار. اخذت النتائج نفس الاتجاه في الحصر الثاني عند 85 يوم من الزراعة. أيضا اظهرت النتائج ان طريقتي الزراعة بالشتل واللقمة احدثت زيادة معنوية في انتاجية محصول الارز بنسبة (16.32 و 6.75 %) و (15.22 و6.31 %) خلال موسمي الزراعة مقارنة بطريقة الزراعة البدار.

أدي استخدام توليفات مبيدات الحشائش (ساتيرن بمعدل 2 لتر فدان$^{-1}$ + انبول 20 جم فدان$^{-1}$)، (ساتيرن بمعدل 2 لتر فدان$^{-1}$ + بازجران بمعدل 1.5 لترفدان$^{-1}$)، (ساتيرن بمعدل 1 لتر فدان$^{-1}$ + انبول بمعدل 20 جم فدان$^{-1}$)، (ساتيرن بمعدل 1 لتر فدان$^{-1}$ + بازجران بمعدل 1.5 لترفدان$^{-1}$) ومعاملة النقاوه اليدوية مرتين الي نقص معنوى فى الوزن الجاف للحشائش الكلية بنسبة 88.6 ، 86.6 ، 84.2 ، 82.4 و 79.0 ٪ ، على التوالي في الموسم الاول عند 65 يوم من الزراعة مقارنة بدون معاملة واخذت النتائج نفس الاتجاة في الحصر الثاني والموسم الثاني. كذلك اظهرت النتائج ان المعاملات السابقة ادت الي زيادة في انتاجية محصول الارز بمقدار (46.7 ، 46.5 ، 37.9 ، 37.8 و 29.0 %) في الموسم الاول و (51.0 ، 51.1 ، 40.2 ، 40.3 ، و 33.4 %) في الموسم الثاني على التوالي مقارنة بدون معاملة.

اظهر التفاعل بين طرق الزراعة وتوليفات معاملات مكافحة الحشائش تأثيرا معنويا علي الوزن الجاف للحشائش الكلية وانتاجية محصول الارز . وكان افضل التفاعلات بين طرق الزراعة (الشتل واللقمة) مع توليفات مكافحة الحشائش (ساتيرن بمعدل 2 لتر فدان$^{-1}$ + انبول 20 جم فدان$^{-1}$) ، (ساتيرن بمعدل 2 لتر فدان$^{-1}$ + بازجران بمعدل 1.5 لترفدان$^{-1}$) حيث أحدث نقص فى الوزن الجاف للحشائش الكلية بنسبة 92.6 و89.6 % عند 65 يوم من الزراعة مقارنة بمعاملة الكنترول تحت ظروف الزراعة البدار. ايضا اظهر التفاعل السابق زيادة في محصول الحبوب حوالي 67.5 و65.5 % مقارنة بمعاملة البدون تحت ظروف الزراعة البدار.

اظهرت النتائج ان منافسة الحشائش لنباتات الارز تحت ظروف الزراعة بالشتل او اللقمة كان ضعيفا مقارنة بطريقة الزراعة البدار علي الرغم من ذلك كان الفرق في المحصول غير معنوى تحت طرق الزراعة الثلاثة وهذا ناشئ عن محدودية منافسة الحشائش لنباتات الارز بسبب توليفات المبيدات المستخدمة.

نستخلص من هذه الدراسة انه يمكن الخروج بحزمة توصيات لادارة الحشائش في حقول الارز حيث سجل اعلي صافي ربح من ناتج المحصول (طن /فدان) باستخدام توليفات مبيدات الحشائش السابقة مع احدي طرق الزراعة (اللقمه او البدار) لزيادة دخل المزارع .

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