Green and Dry Forage Yields of Alfalfa"*Medicago sativa*, L." Populations Subjected to Selection Cycles for Glyphosate Tolerance

M. Abd El- Sattar Ahmed[1*], Ahlam, H. Mostafa[2], Thanaa. I. Milad[3] and T.A. Mahmoud[4]

1 Professor, Crop Science Dept., Fac.Agric. (El-Shatby), Alexandria University (mohamed.a@alexu.edu.eg)
2 Researcher, forage crops section, ARC, Nubaria, Egypt.
3 Professor, Crop Science Dept., Fac.Agric. (El-Shatby), Alexandria University.
4 Head Research, Forage Crops Section, ARC, Nubaria, Egypt.
*; corresponding author.

ABSTRACT

The recent study was an attempt to measure the influence of selection for glyphosate tolerance in alfalfa germplasm on green and dry forage yields. Two cycles of recurrent selection for Glyphosate tolerance were imposed on each of five base population. Evaluation of selected cycles (C_1 and C_2) along with base populations (C_0) was carried out for each population as a split plot design with Glyphosate treatment (+ and -) as main plots and populations (C_0, C_1 and C_2) as a sub –plot. The recorded dry forage yield from the studied population was similar irrespective of glyphosate treatment. Meanwhile, green, and dry forages of studied population, significantly varied ($p\geq0.01$) in ranke or magnitude depending on selection cycle (significant population × selection cycle interaction). In addition, green forage yields of glyphosate treatments significantly varied ($p\geq0.05$) among populations and selection cycles (significant glyphosate treatment × population × selection cycle).The least green forage yield resulted from *C.U.F. 101*population when treated with glyphosate (110.32 ton.ha^{-1}). That was not significantly different from green forage yields produced by any of *Baladi 1*and *Siwa* populations under glyphosate treatment. The highest significant green forage yields were obtained from any of *Siriver* or *Baladi 1* population without glyphosate treatment (194.12 and 142.77 tons. ha^{-1} for the former and the latter, respectively). On another words, the most sensitive population to glyphosate treatment in terms of green forage yield was *Baladi 1*, since, it produced the least green forage yield with glyphosate application (110.91 tons.ha^{-1}) *versus* significantly the highest green forage yield without glyphosate application (192.77 tons.ha^{-1}).The least green forage yield resulted from *C.U.F. 101*population when treated with glyphosate (110.32 ton.ha^{-1}).That was not significantly different from green forage yields produced by any of *Baladi 1*and *Siwa* populations under glyphosate treatment.Response of dry forage yield to population × selection cycles interaction took similar pattern to what noticed in green forage yield. *C.U.F. 101* showed a significant reduction of 10.26% in dry forage yield of cycle two relative to cycle one. While, *Hasawi* population, recorded a significant increase in dry forage yield of 15.52% with the second cycle of selection relative to cycle one. *Siwa* population, showed lowering in dry forage yield with one cycle of selection for glyphosate tolerance (-7.373%) and an increase of 6.998% at second cycle of selection relative to cycle one.

Keywords: Selection, Glyphosate Tolerance, Green Forage, Dry Forage, Alfalfa .

INTRODUCTION

The registration of the new alfalfa variety Roundup Ready ® started by mid-2005. The new variety came-up after the translocation of resistance-gene to alfalfa germplasm. That enable the new plant to resist the effects of general eradication herbicide "glyphosate". The good consequences of adopting such new type of cultivars includes an improvement in yield, quality and turn- over. Also, glyphosate is a short-durated herbicide in soil, with very limited influences on soil Flora and Fauna, beside,safe- effect on mammals. The bad cide in adopting cide-tolerant alfalfa cultivar is the shift in weed communities with rise proportion of tolerant species. Miller *et al*. (2006), summarized the benefits of using Roundup Ready ® alfalfa in North states as; 1) better control of noxious-weed species, 2) insure less botanical injury- indicators, 3) Provide flexible management practice regarding the time of application, previelling weather, 4) reduce weed competition allowing fore better establishment and good forage quality, 5) ensure the use of pre- tested safe- herbicide, and 6) secure high quality hay free-from noxious weeds. The expected increase in yield with this new technology reached about 1.4 to 3.3 ton. acre^{-1} Late application of glyphosate to alfalfa Fields caused a reduction in yield reached 0.3 to 0.8 ton. ha^{-1} .

Glaspie*et al.*(2011). Insured the value of introducing glyphosate- resistant alfalfa to cropping systems. They related its value to the required seeding-rate, yield and quality of forage. From an experiment during two years on the relation between using glyphosate- resistant alfalfa cultivar, seeding rates and weed control programs, they emphasized the positive role using such cultivars. Orloff and Putnam (2011). Discussed the good and bad consequences of used roundup ready alfalfa cultivar. Growers of alfalfa at majority were satisfied with good consequences of new cultivar. They related their acceptance to this new cultivar to good limitation of weed competition, flexible application, and potentiality of culminating bad weeds. They also reported a higher forage yield and better-quality forage.

Beside the new glyphosate- tolerance gene that was adopted to alfalfa, another gene "Harvxtra" was introduced to a new germplasm (FONSI; USDA-APHIS, 2014**).** Acceptance of both engineered characters by farmers now a day still doubtful.

Daniel *etal*. (2016). Considered the situation for genetically engineered alfalfa cultivars in countries that don't permits the use of such genotypes, because of organic crop production. They noted that farmers might produce non- genetically engineered hay for sensitive markets and engineered hay for non- sensitive markets. Miller *etal*. (2016). Considered the contribution of using roundup ready alfalfa to weed management in fields. The studied treatments included glyphosate doses and timing. They also- included the standard control means. They reached an increase in yield with increasing seeding rate and with applying glyphosate. Forage quality insignificantly affected by any of the studied treatments. Boerboom *et al.*(1991), evaluated birds-foot trefoil after glyphosate treatment. Their results showed that, shoot weight of the three studied cycle-two populations were about 44 to 85% greater than base population, indicating increased glyphosate tolerance. Regrowth of trefoil showed an increase in weight reached 44 to 127% in cycle two populations. Miller *et al.*(2006), recorded an increases in herbicide-treated plots ranged from 1.4 to 3.3 tons per acre. They added that, alfalfa yields were highest in glyphosate-treated plots, where, weeds were removed at the two-trifoliate leaf stage of alfalfa or earlier. Delaying glyphosate application until four-trifoliate late leaf stage reduced alfalfa yields by 0.3 to 0.8 ton/acre. They added that, alfalfa yields were 0.1 lower to 0.9 higher (ton/acre) in glyphosate-treated plots. Glaspie *et al.*(2011), found that, alfalfa yield was greater when treated with glyphosate. Zobiole *et al.*(2011), reached that,glyphosate treatment reduced yield components such as photosynthesis, water absorption, nutrient uptake and symbiotic nitrogen fixation in glyphosate-tolerant soybean cultivars. They added that, data that explain the effect of glyphosate on physiology of soybean is lacking.

Research results regarding the consequences of improving alfalfa tolerance to glyphosate in Egypt is relatively scare. The recent study was an attempt to measure the influence of selection for glyphosate tolerance in alfalfa germplasm on green and dry forage yields under glyphosate treatments (+ / -).

MATERIALS AND METHODES

Alfalfa plant materials (*Medicago sativa*,L**.**) used in that recent study will be referred to five base populations .Two cycles of recurrent selection for Glyphosate tolerance were imposed on each base population. Each cycle of selection within a base germplasm is hereafter referred to as a population.

C.U.F 101 population Pedigree was (University of California Davis, UC 76, 1972, released by C.U.F seed company). *Siriver* population (Hunter river x *C.U.F* 101 and UC 110 and UC 112),.*Hasawi* population is a land race naturally originated on Saudi Arabia. *Baldi*1 population Selected from EL-Wadi EL-Gedid landrace by Forage Research Department of ARC, Egypt. *Siwa* population is a land race naturally originated on Siwa Oasis of western-desert, Egypt.

Cycle one was practiced on 2800 plants per each base population (C_0). Base populations were seeded at density of 100 plant.m^{-2}(considering seed index and germination percentages). Each germplasm seeded in 28 m^2 (20 rows of 1.75m long and 0.80 m apart) on Nubaria Agricultural Research Station, North of Egypt. Seeding date was, May 27th, 2015. Four weeks after seeding, plants (8-15 cm tall) were treated with 0.56 kg acid equivalent per hectare (ae. ha^{-1}) of Glyphosate (Round up®) diluted in 480 liter of water (L). Survived plants were left to complete the first cutting growth (two months). Regrowth of the second cutting at 20-25 cm height was sprayed by 0.84 kg ae. ha^{-1} glyphosate in 480 L water. ha^{-1}. 14 day after treatment, plants was rated for injury on a 1 to 4 scale (where 1= uninjured, 2=injured shoot, 3=dead shoot with live auxiliary shoots and 4= dead seeding) (Boerboom *et al.* 1991). The uninjured plants were selected uprooted and transplanted to an isolated plots surrounded and covered by insect proof cloth for flowering and seed setting .Plants selected for Glyphosate tolerance from each germplasm were 100 plant .Each germplasm was caged separately in cloth house and a portable honey bees heave (*Apis mellifera, L.)* was used as pollinators (for random matting among plants). Seeds were harvested for each separate plant as a half-sib family on June, 15 th,2016.Equale seed weight from each selected half-sib family seeds were bulked to from first improved cycle (C_1).The second cycle of selection was practiced for each separate improved population. Each population was seeded in 20 rows of 1.25m. long and 0.80 m apart (2000 plant). Four-week-old seedlings were treated with Glyphosate at 0.56 kg ae. ha^{-1} in 480 liters of water. Fourteen days after treatment, injury levels were rated as 1= uninjured, 2=injured shoot, 3=dead shoot with live auxiliary shoots and 4= dead seeding. The uninjured plants were selected uprooted and transplanted to an isolated plot surrounded and covered by insect proof cloth for flowering and seed setting. Plants selected for Glyphosate tolerance from each germplasm were 100 plant. Each germplasm was caged separately in cloth house and a portable honeybees heave (*Apis mellifera L.)* was used as pollinators (for random matting among plants). Seeds were harvested for each separate plant as a half-sib family on June 15 th, 2017.Equale seed weight from each selected half-sib family seeds were bulked to from second improved cycle (C_2).

Evaluation of selected cycles (C_1 and C_2) along with base populations (C_0) was carried out for each population as a split plot design with Glyphosate treatment (+ and -) as main plots and populations (C_0, C_1 and C_2) as a sub –plot. Four replicates were used. Plot size was three rows of 1.80 m long and 0.15 m apart. Planting of seeds took place at November 1st, 2017. Glyphosate treatment was applied 30 days after planting at 0.84 kg ae. ha^{-1} in 480 liters of water. Glyphosate treated and untreated plots were evaluated for the following characters:

1- Green forage yield (ton per hectare): total plots were harvested weighted and transformed to ton. $hectare^{-1}$, prior to statistical analysis. Data were recorded for ten cuttings.

2- Dry forage yield (ton per hectare): determined from dry matter percentage and green forage yield of each plot.

Data of all experiments were subjected to analysis of variance according to Cochran and Cox, 1957. Means were separated by a protected L.S.D. test (Fisher, 1960). Mstat-c package was used in all analysis.

RESULTS AND DISCUSSION

Response of alfalfa populations (five populations) and selection cycles to glyphosate tolerance (three cycles) under presence and absence of glyphosate treatment (+ and -) in terms of green and dry forage yields were illustrated in Table 1. Over populations and selection cycles, variable ($p\geq0.01$) green and dry forage yields were recorded with presence or absence of glyphosate treatments. Also, the studied population gave different ($p\geq0.05$) green forage yields. That was not true for dry forage yields that were significantly similar. In the meantime the obtained green forage yield from the studied populations significantly varied ($p\geq0.01$) depending on glyphosate treatment (+ or -) (significant glyphosate treatment × population interaction). While, the recorded dry forage yield from the studied population was similar irrespective of glyphosate treatment. Meanwhile, green and dry forages of studied population, significantly varied ($p\geq0.01$) in ranke or magnitude depending on selection cycle (population × selection cycle interaction). In addition, green forage yields of glyphosate treatments significantly varied ($p\geq0.05$) among populations and selection cycles (significant glyphosate treatment × population × selection cycle). The latter was not true in case of dry forage yields.

Table (1): Mean squares of green and dry forage yields for alfalfa population as affected by glyphosate treatments and selection for glyphosate tolerance.

S.O.V	d.f.	M.S	
		Green forage yield	Dry forage yield
Glyphosate treatment (G)	1	153498**	6667 **
Rep /Glyphosate	3	852.3	61.65
Population (P)	4	361.9*	13.53 n.s.
GXP	4	425.3**	20.62 n.s.
Selection cycle (S)	2	263.9 n.s.	21.91 n.s.
GXS	2	184.5 n.s.	15.44 n.s.
PXS	8	1048 **	76.79**
GXPXS	8	233.9*	11.39 n.s.
Error	84	103	7.425

*, ** significant at 0.05 and 0.01 levels of probability, respectively.
n.s not significantly different at 0.05 level of probability.

Means of green and dry forage yields for the three studied main factors, i.e; glyphosate treatment, population and selection cycle were illustrated in Table (2). Glyphosate untreated selection cycles in all studied populations gave 1.617 and 1.586 times higher green and dry forage yields (187.4 *vs.* 115.9 and 40.34 *vs.*25.43 tons.ha^{-1} green and dry forages, respectively). Also, *Siriver* population significantly gave the highest green forage yield of 157.3tons.ha^{-1}. Meanwhile, the other studied alfalfa populations gave similar green forage yield. Over glyphosate treatments and populations, selection cycles for glyphosate tolerance gave similar green and dry forage yields, since, the improvement in yields due to selection failed to reach the level of significance.

Table (2): Mean of forage yield for Glyphosate traded, alfalfa base population selection cycles

Factors	Level of factor	Green forage yield(t.ha^{-1})	Dry forage yield t.ha^{-1})
Glyphosate	Treated	115.9	25.43
	Untreated	187.4	40.34
L.S.D $_{0.05}$		13.04	3.507
Population	*C.U.F 101*	148.3	32.35
	Hasawi	153.1	33.71
	Siravar	157.3	33.31
	Baladi 1	151.8	33.18
	Siwa	147.8	31.88
L.S.D $_{0.05}$		5.800	n.s
Selection cycles	C_0	149.5	32.39
	C_1	154.5	33.74
	C_2	150.9	32.52
L.S.D $_{0.05}$		n.s	n.s

$^{n.s}$.; not significantly different.

L.S.D. $_{0.05}$; least significant difference at 0.05 levels.

Forage yields (green and dry) as affected by the first order interaction between population and glyphosate treatment were presented in Table (3). The least green forage yield resulted from *C.U.F.* 101population when treated with glyphosate (110.32 ton.ha^{-1}). That was not significantly different from green forage yields produced by any of *Baladi 1*and *Siwa* populations under glyphosate treatment. While, the highest significant green forage yields were obtained from any of *Siriver* or *Baladi* 1 population without glyphosate treatment. (194.12 and 142.77 tons.ha^{-1} for the former and the latter, respectively). On anther words, the most sensitive population to glyphosate treatment in terms of green forage yield was *Baladi 1*, since, it produced the least green forage yield with glyphosate application (110.91 tons.ha^{-1}) *versus* significantly the highest green forage yield without glyphosate application (192.77 tons.ha^{-1}). This clearly indicate a reduction associated with glyphosate application reached 42.47%. Dry forage yield was affected by population × glyphosate treatment in similar manner. The least significant dry forage yields were produced by any of *C.U.F101*, *Baladi* 1 and *Siwa* population when treated by glyphosate (24.58, 24.63 and 24.47 tons.ha^{-1} for the three successive populations, respectively). While, the highest significant dry forage yields were those of *Baladi* 1 population without glyphosate treatment (41.73 ton.ha^{-1}). In the meantime, *Baladi 1* population might be considered as the most vulnearable to glyphosate treatment in terms of dry forage yield with areduction rate reached 41.98% due to glyphosate treatment.

Table (3): Means of green and dry forage yields as affected by the interaction betweenAlfalfa populations and glyphosate treatment

Population	Green forage yield (t. ha^{-1})		Dry forage yield (t. ha^{-1})	
	Treated	Untreated	Treated	Untreated
C.U.F 101	110.32	186.25	24.58	40.12
Hasawi	122.76	183.42	27.72	39.71
Sirivar	120.54	194.12	25.75	40.86
Baladi 1	110.91	192.77	24.63	41.73
Siwa	115.01	180.63	24.47	39.29
L.S.D $_{0.05}$	8.203		2.202	

L.S.D.; least significant difference at 0.05 level of probability

Means of green and dry forage yields as affected by the interaction between alfalfa populations and selection cycles for glyphosate tolerance were shown in Table (4). Green forage yields of the studied population respond differently to selection cycles. *C.U.F.* 101 population recorded an increase with the first cycle of selection for glyphosate tolerance (2.499%), along with reduction in green forage yield with the progress of selection to cycle two, relative to cycle one (-8.48%). Those changes in green forage yield had not reached the level of significance. As for *Hasawi* population, selection for glyphosate selection for one and two cycles caused an increase in green forage yield (6.310and 9.982% increase for cycle one and two relative to base and cycle one respectively). The yield increase that obtained in cycle two had reached the level of significance. *Siriver* population, recorded an increase in green forage yield with cycle one and two of selection reached 4.554 and 5.204% relative to the preceding cycles, respectively. Those increase, although, were sound had not reached the level of significance. *Baladi* 1 population, paradoxically, recorded an increase in green forage yield in cycle one of selection of 5.970% relative to the base population, along with a reduction of 20.20% for cycle two of selection, relative to cycle one. *Siwa* population, recorded insignificant change in green forage yield with selection cycles reached -2.689 and +3.787% for cycle one and two relative to base and cycle one, respectively.

Table (4): Means of green and dry forage yields as affected by the interaction between alfalfa populations and selection cyclesfor glyphosate tolerance.

Population	Selection cycle	Green forage yield (t.ha^{-1})	Relative to		Dry forage yield (t.ha^{-1})	Relative to	
			C_0	C_1		C_0	C_1
C.U.F 101	C_0	150.1			32.89		
	C_1	153.9	2.499 $^{n.s.}$		33.82	2.816	
	C_2	140.8		-8.480*	30.34		-10.26*
Hasawi	C_0	142.1			30.38		
	C_1	151.1	6.310 $^{n.s.}$		32.84	8.081*	
	C_2	166.1		9.982*	37.93		15.52*
Sirivar	C_0	150.1			32.13		
	C_1	156.9	4.554 $^{n.s.}$		34.32	6.816*	
	C_2	165.1		5.204 ^{ns}	33.46		-2.500 ^{ns}
Baladi 1	C_0	156.8			33.76		
	C_1	166.1	5.970 ^{ns}		37.35	10.62*	
	C_2	132.6		-20.20*	28.43		-23.87*
Siwa	C_0	148.7			32.78		
	C_1	144.7	-2.689 ^{ns}		30.36	-7.373 ^{ns}	
	C_2	150.1		3.787 ^{ns}	32.49		6.998 ^{ns}
L.S.D $_{0.05}$		10.04			2.697		

C_0; base population. C_1; cycle one of selection. C_2; cycle two of selection.

Response of dry forage yield to population × selection cycles interaction took similar pattern to wheat noticed in green forage yield. *C.U.F.* 101 showed a significant reduction of 10.26% in dry forage yield of cycle two relative to cycle one. While, *Hasawi* population, recorded a significant increase in dry forage yield of 15.52% with the second cycle of selection relative to cycle one. *Baladi* 1 population scored an increase of significant magnitude with the first cycle of selection for glyphosate tolerance (10.62% relative to the base population), Whereas, in contrary a reduction of 23.87% in dry forage yield of cycle two relative to cycle one was realized. That reduction was significant. *Siwa* population, showed lowering in dry forage yield with one cycle of selection for glyphosate tolerance (-7.373%) and an increase of 6.998% at second cycle of selection relative to cycle one.

Second order interactionamong alfalfa populations × selection cycles × glyphosate treatment for green forage yield was presented in Table (5). *C.U.F.* 101population after one cycle of selection for glyphosate tolerance gained insignificant increase of 0.691 and 3.687% of the respective base population yield when evaluated under glyphosate treatment and lack of glyphosate treatment, respectively. While, the second cycle of selection associated with a significant green forage yield reduction of -15.33% relative to yield of preceding cycle, when evaluated under glyphosate treatment *versus* insignificant reduction of -4.288% relative to cycle one green forage yield when evaluated under glyphosate treatment. *Hasawi* population scored increases in green forage yield with the advancement of selection cycles, regardless of glyphosate treatment level (7.247 and 21.64% increase in first and second cycles green forage yield, relative of yield of previous cycle). The latter increase in green forage yield of second cycle was significant. Insignificant increase associated with progress of selection, reached 5.711 and 2.53% relative to base population and first cycle yields when evaluated under glyphosate treatment. *Siriver* population, showed insignificant increases with progress of selection for glyphosate tolerance irrespective of evaluation protocol (under glyphosate treatment or lack of treatment). *Baladi 1* population, showed a bidirectional response in green forage yield to selection for glyphosate tolerance, since, the first cycle gave an increase reached 13.30 (significant) and 2.053 (insignificant) from evaluation under glyphosate treatment and lack of treatment, respectively, while, the second cycle had a significant decrease in green forage yield of -18.94 and -20.93% relative to cycle one under glyphosate treatment and lacl of treatment, respectively. Responses of *Siwa* population were insignificant relative to base and cycle one of selection irrespective of glyphosate treatment.

Table (5): Mean of forage yield of interaction between alfalfa base populations and treated by Glyphosate

Population	Selection cycle	Green forage yield (t. ha^{-1})						Dry forage yield (t. ha^{-1})	
		Treated	Relative to		Untreated	Relative to		Treated	Untreated
			C_0	C_1		C_0	C_1		
C.U.F 101	C_0	115.7			184.4			25.66	40.11
	C_1	116.5	0.691^{ns}		191.2	3.687^{ns}		26.09	41.53
	C_2	98.64		-15.33^{*}	183.0		-4.288	21.99	38.69
Hasawi	C_0	109.0			175.1			23.70	37.05
	C_1	116.9	7.247^{ns}		185.1	5.711^{ns}		26.21	39.45
	C_2	142.2		21.64^{*}	189.9		2.53	33.24	42.61
Siravar	C_0	116.3			183.7			25.39	38.87
	C_1	120.3	3.439^{ns}		193.4	5.280^{ns}		26.20	42.43
	C_2	124.8		3.740^{ns}	205.2		6.101	25.66	41.26
Baladi 1	C_0	109.0			204.5			23.78	43.74
	C_1	123.5	13.30^{*}		208.7	2.053^{ns}		28.15	46.53
	C_2	100.1		-18.94^{*}	165.0		-20.93	21.96	34.89
Siwa	C_0	111.8			185.4			23.71	41.84
	C_1	110.8	-0.894^{ns}		178.4	-3.775^{ns}		23.66	37.05
	C_2	122.3		10.37^{ns}	177.9		-0.280	26.02	38.95
L.S.D $_{0.05}$		14.20						n.s.	

n.s.; not significantly different

The recent results might be considered in a comparison to other researchers results. Boerboom *et al.* (1991), evaluated birds-foot trefoil after glyphosate treatment. Their results showed that, shoot weight of the three studied cycle-two populations were about 44 to 85% greater than base population, indicating increased glyphosate tolerance. Regrowth of trefoil showed an increase in weight reached 44 to 127% in cycle two populations. Miller *et al.* (2006), recorded an increases in herbicide-treated plots ranged from 1.4 to 3.3 tons per acre. They added that, alfalfa yields were highest in glyphosate-treated plots, where, weeds were removed at the two-trifoliate leaf stage of alfalfa or earlier. Delaying glyphosate application until four-trifoliate late leaf stage reduced alfalfa yields by 0.3 to 0.8 ton/acre. They added that, alfalfa yields were 0.1 lower to 0.9 higher (ton/acre) in glyphosate-treated plots. Glaspie *et al.* (2011), found that, alfalfa yield was greater when treated with glyphosate. Zobiole *et al.* (2011), reached that, glyphosate treatment reduced yield components such as photosynthesis, water absorption, nutrient uptake and symbiotic nitrogen fixation in glyphosate-tolerant soybean cultivars. They added that, data that explain the effect of glyphosate on physiology of soybean is lacking.

In conclusion:

– Over populations and selection cycles, variable ($p\geq0.01$) green and dry forage yields were recorded with presence or absence of glyphosate treatments. Also, the studied population gave different ($p\geq0.05$) green forage yields. That was not true for dry forage yields that were significantly similar. In the meantime, the obtained green forage yield from the studied populations significantly varied ($p\geq0.01$) depending on glyphosate treatment (+ or -) (significant glyphosate treatment × population interaction). The recorded dry forage yield from the studied population was similar irrespective of glyphosate treatment. Meanwhile, green, and dry forages of studied population, significantly varied ($p\geq0.01$) in ranke or magnitude depending on selection cycle (significant population × selection cycle interaction). In addition, green forage yields of glyphosate treatments significantly varied ($p\geq0.05$) among populations and selection cycles (significant glyphosate treatment × population × selection cycle).

– The least green forage yield resulted from *C.U.F. 101*population when treated with glyphosate (110.32 ton. ha^{-1}). That was not significantly different from green forage yields produced by any of *Baladi 1*and *Siwa* populations under glyphosate treatment. The highest significant green forage yields were obtained from any of *Siriver* or *Baladi 1* population without glyphosate treatment. (194.12 and 142.77 tons. ha^{-1} for the former and the latter, respectively). On another words, the most sensitive population to glyphosate treatment in terms of green forage yield was *Baladi 1*, since, it produced the least green forage yield with glyphosate application (110.91 tons.ha^{-1}) *versus* significantly the highest green forage yield without glyphosate application (192.77 tons.ha^{-1}).

– Response of dry forage yield to population × selection cycles interaction took similar pattern to wheat noticed in green forage yield. *C.U.F. 101* showed a significant reduction of 10.26% in dry forage yield of cycle two relative to cycle one. While, *Hasawi* population, recorded a significant increase in dry forage yield of 15.52% with the second cycle of selection relative to cycle one. The first cycle of selection for glyphosate tolerance gave an increase (10.62% relative to the base population), Whereas, in contrary a reduction of 23.87% in dry forage yield of cycle two relative to cycle one was realized. That reduction was significant. *Siwa* population, showed lowering in dry forage yield with one cycle of selection for glyphosate tolerance (-7.373%) and an increase of 6.998% at second cycle of selection relative to cycle one.

LITERATURE CITED

Boerboom C.M, N.J, Ehlke D.L Wyse and D.A Somers. 1991. Recurrent selection for glyphosate tolerance in Birdsfoot Trefoil. Crop sci.31;1124-1129.

Daniel, H. P., T.Woodward, P.Reisen, and S.Orloff 2016. Coexistence and Market assurance for Production of non–genetically engineered alfalfa hay and forage in a biotech Era. Crop Forage Turfgrass Manage (2)1:13.

Fisher ,R.A. 1960. The Designs of Experiments. 7 th. Ed. Oliver&Boyd, Edinburgh.

Glaspie C.F, S.A McCordick, T.S Dietz, J KellsJ., H.R Leep, and W.J Everman.2011. Effect of Seeding Rate and Weed Control on Glyphosate-Resistant Alfalfa Establishment. Weed Technology 25(2);230-238. Doi: http://dx.doi.org.

Miller S.D, R.G, Wilson A.R Kniss and C.M.Alford 2006.Roundup Ready® Alfalfa A new technology for high plains hay producers. Jenna Norfolk, College of Agriculture intern.

Miller S.D. and. C.M. Alford 2016.Weed Control and Glyphosate Tolerant Alfalfa Response to Glyphosate Rate and Application Timing. (W-miller131842-oral).

MSTAT-C.(1996). Russel, D.Freed, MSTAT Director, Crop and soil Sciences Department, Michigan State University , U.S.A.

Muooz-Rueda A., C.Gonzalez-Murua, J.M. Becerril and M.F.Slnchez-Deaz 1986. Effects of

Orloff. S. and Putnam .D.2011.Roundup ready® alfalfa- what have we learned to date.Western Alfalfa & Forage Conference, http://alfalfa.ucdavis.edu.

Zobiole L. H. S, R.J Kremer, R. S. Oliveira and .J Constantin. 2011. Glyphosate affects chlorophyll, nodulation and nutrient accumulation of ‘‘second generation’’ glyphosate-resistant soybean (*Glycine max*, L.) a Pesticide Biochemistry and Physiology 99; 53-60.

ZobioleL.H.S , R.S. Oliveira Jr., R.J. Kremer, A.S. Muniz and A. Oliveira Jr.2010. Nutrient accumulation and photosynthesis in glyphosate resistant soybeans is reduced under glyphosate use. J. Plant. Nutr. 33; 1860-1873.

محصول العلف الاخضر والجاف لعشائر البرسيم الحجازى بعد دورات من الانتخاب لتحمل الجليفوسات

محمد عبد الستار احمد و احلام حسنى مصطفى و سناء ابراهيم ميلاد و طه احمد محمود

الدراسة الحالية محاولة لقياس تأثير الأنتخاب لتحمل مبيد الجليفوسات في الوعاء الجيني للبرسيم الحجازي علي صفات محصول العلف الأخضر والجاف. تم تنفيذ دورتان من الأنتخاب الدوري لتحمل الجليفوسات في كل من خمس عشائر اساس لتقييم ناتج الدورات مع عشائر الاساس اجريا منفصلاً لكل عشيرة في تصميم قطع منشقة حيث مثلت المعاملة بالجليفوسات(±) القطع الرئيسية الثانية بينما وضعت دورات الانتخاب (الاساس, الدورة الأولي, الدورة الثانية) في القطع المنشقة. قيم محصول العلف الجاف المسجلة للعشائر المدروسة كانت متماثلة بغض النظر عن المعاملة بالجليفوسات. في حين أن كل من محصول العلف الأخضر والجاف الناتج من العشائر المدروسة اختلفت في الترتيب أو في القيمة اعتماداً علي تطور دورات الأنتخاب (تفاعل معنوي بين العشائر ودورات الأنتخاب). يضاف إلي ذلك أن محصول العلف الأخضر للقطع المعاملة بالجليفوسات اختلف معنوياً بين العشائر المدروسة ودورات الأنتخاب (تفاعل معنوي بين المعاملة بالجليفوسات × العشيرة × دورة الأنتخاب). وقد نتج أقل محصول علف أخضر من عشيرة (C.U.F.101) عن الكمية المختلفة عن كميات العلف الأخضر التي تنتج من كل من عشيرة بلدي١, سيوة تحت ظروف النعاملة بالجليفوسات. أعلي محصول علف أخضر نتج عن اي من العشائر ساي ريفر أو بلدي١ بدون المعاملة بالجليفوسات (١٩٤,١٢, ١٤٢,٧٧ طن/هكتار للأول والثاني علي الترتيب). وبمعني آخر فإن أكثر العشائر حساسية للمعاملة بالجليفوسات معبراً عن ذلك في صورة محصول علف أخضر كانت عشيرة بلدي١ حيث كانت أقل محصول علف أخضر عند المعاملة بالجليفوسات (١١٠,٩١ طن/هكتار) في مقابل أعلي محصول علف أخضر بدون معاملة بالجليفوسات (١٩٢,٧٧ طن/هكتار) وتشابه معه الناتج من العلف الأخضر بدون فروق معنوية كل من بلدي١ وسيوة تحت ظروف المعاملة بالجليفوسات وقد أعطي محصول العلف الجاف استجابة مماثلة للعلف الأخضر لتفاعل العشيرة في دورة الأنتخاب حيث أنخفض محصول العلف الجاف لعشيرة C.U.F.101 بمقدار ١٠,٢٦% بعد الدورة الثانية من الأنتخاب مقارنة بالدورة الأولي للأنتخاب بينما سجلت عشيرة حساوي زيادة في محصول العلف الجاف مقداره ١٥,٥٢% بعد الدورة الثانية من الأنتخاب بالنسبة للدورة الأولي. كما أظهرت العشيرة سيوة إنخفاض في محصول العلف الجاف بعد دورة واحدة من الأنتخاب لتحمل الجليفوسات (٧,٣٧٣) وزيادة بعد الدورة الثانية من الأنتخاب بلغت ٦,٩٩٨ بالنسبة للدورة الأولي.