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Possibilities for chemical control of the weeds at chickpea (*Cicer arietinum* L.)

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ABSTRACT

In 2015 a field trail with the chickpea variety „Plovdiv 8" was conducted. The trial was conducted on the agricultural land of village Alexandrovo, municipaly of Yambol city. The following 7 herbicide products were evaluated for their efficacy: Spectrum (720 g/l dimethenamid-P), Stomp Aqua (455 g/l pendimetalin), Afalon 45 SC (450 g/l linuron), Pulsar 40 (40 g/l imazamox), Korum SL (224 g/l imazamox + 480 g/l bentazon), Bazagran 480 SL (480 g/l bentazon) and Stratos Ultra (100 g/l cycloxydim). The herbicides were applied in the spring after sowing before germination of the crop (BBCH 00-03), as well as during the vegetation in phenophase 2^{nd} – 4^{th} leaf (BBCH 12-14) and 6^{th} - 8^{th} leaf (BBCH 16-18). The efficacy of herbicides by the 10 score visual scale of EWRS was recorded. The results were compared with untreated controls. Herbicides phytotoxicity by 9 score scale of EWRS was established.. The highest herbicide efficacy was obtained at the variant treated with Korum SL + Dash in rate of 1.25 + 0.625 l/ha. The highest phytotoxicity was recorded at the variant with Basagran 480 SL + Stratos Ultra in rates of 2.0 + 2.0 l/ha.

Key words: chickpea, weeds, herbicides, selectivity, efficacy

Introduction

Chickpea (*Cicer arietinum* L.) is grown for its seeds. They contain proteins in rates approximately as the protein content in bean, but the quantity of fats, vitamins A and B_1 and minerals is higher (Pehlivanov et al, 1998). Chickpeas can be used as a high energy and protein feed also in animal diets to support milk, meat and/or egg production (Bampidis and Christodoulou, 2011). In the Chickpea fields in Bulgaria the most common weeds are field bindweed (*Convulvulus arvensis* L.), black bindweed (*Fallopia convolvulus* L.), fat-hen (*Chenopodium album* L.), common amaranth (*Amranthus retroflexus* L.), black nightshade *(Solanum nigrum* L.), charlock (*Sinapis arvensis* L.), creeping thistle (*Cirsium arvense* L.), etc. (Tonev, 2000). A field experiment was conducted during 2009-10 and 2010-11 to study the response of post-emergence herbicides on growth and yield of chickpea grown in clayey soil. Among herbicides highest yield was recorded with application of imazethapyr and quizalofop-ethyl at rate 75 g/ha (Goud et al., 2013). Two years of trials conducted by Kantar et al., 1999 showed that herbicide application considerably increased chickpea yield. Americanos and Droushiotis (1998) concluded that the choice of herbicide must be decided primarily on the basis of the predominant weeds, while the rate of application is dependent on soil type.

The aim of our study was to determine the possibilities for chemical control of the weeds at chickpea.

Materials and Methods

The trial was conducted on the agricultural land of village Alexandrovo, municipality of Yambol city. The experiment was performed by the randomized block design in 3 replications (Dimova and Marinkov, 1999) under non irrigated conditions in 2015. The study was with 13 variants. The size of the harves plot was 14 m^2. The efficacy of the folowing 3 soil herbicides and 4 foliar herbicides was evaluated:

Table 1. Variants of the trial

Variants Herbicides	Active substances	Rates l/ha	Phenophase (BBCH)
1. Untreated control	-	-	-
2. Spectrum	720 g/l dimethenamid-P	1.4	00-03
3. Stomp Aqua	455 g/l pendimethalin	3.0	00-03
4. Afalon 45 SC	450 g/l linuron	3.0	00-03
5. Pulsar 40	40 g/l imazamox	1.25	00-03
6. Pulsar 40	40 g/l imazamox	1.0	00-03
7. Pulsar 40	40 g/l imazamox	1.0	16-18
8. Pulsar 40	40 g/l imazamox	0.75	16-18
9. Pulsar 40	40 g/l imazamox	0.5	16-18
10. Korum SL + the ajuvant Dash	224 g/l imazamox + 480 g/l bentazon+ 406 g/l c-65 Methylesters + 244 g/l klearfac AA-270	1.25 + 0.625	16-18
11. Korum SL + the ajuvant Dash	224 g/l imazamox + 480 g/l bentazon + 406 g/l c-65 Methylesters + 244 g/l klearfac AA-270	1.0 + 0.5	16-18
12. Bazagran 480 SL+Stratos Ultra	480 g/l bentazon	2.0	12-14
	100 g/l cycloxydim	2.0	16-18
13. Bazagran 480 SL+ Stratos Ultra	480 g/l bentazon	1.0	12-14
	100 g/l cycloxydim	2.0	16-18

The herbicide efficacy was compared with untreated control. All sistemic soil herbicides were apllied after sowing before germination of the crop. Foliar herbicides were applied in different chickpea growth stages (Table 1). In the study the Chickpea variety „Plovdiv 8" was used. The plant density was 40 plants per 1 m². Herbicides were applied with back sack sprayer for plot trials (brand "Solo"). The expense of spray solution was 250 l/ha. Predecessor of chickpea in the crop rotation was winter wheat. After the wheat harvest plowing at 20-22 cm depth was done. Before this tillage, fertilization with 450 kg/ha P_2O_5 and 400 kg/ha K_2O was apllied. Before the crop sowing two times cultivation and fertilization with nitrogen at rate of 220 kg/da N was acomplished. The efficacy of the soil herbicides was recoreded on the 40th, 54th and 82nd day, and the efficacy of the foliar herbicides was recorded on the 14th, 28th and 56th day after treatments. The efficacy of the herbicides was evaluated by the visual scale of EWRS (European Weed Research Society). The level of phytotoxicity by the 9 score scale of EWRS was determined. At score 0 there are no damages on the crop, and at score 9 the crop is copletetly destroyed.

Results and Discussions

Chickpea is a poor competitor with weeds at all stages of growth. Slow growth during the seedling stages, in addition to a relatively sparse optimum plant population causes an open crop canopy which requires long season weed management (McKay et al., 2002). There is large number of possibilities to chemical weed control (Fetvadzieva et al., 1991). The weed population was consisted of fat-hen (*Chenopodium album* L.), knotgrass (*Polygonum aviculare* L.), scented mayweed (*Matricaria tenuifolia* Kit.), bottlegrass (*Setaria viridis* L.), barnyard grass (*Echinochloa crus-galli* L.), field bindweed (*Convolvulus arvensis* L.) and yuncker (*Cuscuta campestris* Yunck.). In 2015 the average weed density per 1 m² were as follows: C. album – 7.5 specimens; P. aviculare – 4.5 specimens; M. tenuifolia – 8.5 specimens; S. viridis – 7.0 specimens; E. crus-galli – 6.0 specimens; C. arvensis – 12.0 specimens and C. campestris – 24.0 specimens per 1 m².

The efficacy of the studied herbicides against the weeds is shown on Table 2. The highest efficacy was accomplished after the treatment with Korum SL - 1.25 l/ha + Dash – 0.625 l/ha. With the deacresing of the rates of those two products their effect was diminished (variant 11). The herbicide Spectrum had very good and excelent effect aganst the scented mayweed, bottlegrass and barnyard grass respectivelly. Insufficient efficacy against fat-hen (70%) was recorded. The herbicide did not affect the weeds knotgrass, field bindweed

and yuncker. According to Abbas et al. (2016), pendimethalin at rate of 3.35 l/ha was the most effective pre-emergence herbicide for weed control at chickpea and also increased the yield. In our study that statement was not observed. Pendimethalin and pendimethalin + dimethenamid-P provided acceptable weed control at irrigated conditions of the trial conducted by Lyon and Wilson (2005). In our study the application of Stomp Aqua (455 g/l pendimethalin) at rate of 3.0 l/ha was ineffective against scented mayweed. The cotrol of fat-hen, knotgrass, bottlegrass and barnyard grass was insufficient, and the efficacy against the field bindweed and yuncker was null.

Table 2. Efficacy of the herbicides at chickpea

Variants / Herbicides	Rates l/ha	Pheno-phase (BBCH)	Efficacy of the foliar herbicides on 56th day after treatments and of the soil herbicides on 82nd day after applicaton (by EWRS)						
			Chenopodium album	*Polygonum aviculare*	*Matricaria tenuifolia*	*Setaria viridis*	*Echinochloa crus-galli*	*Convolvulus arvensis*	*Cuscuta campestris*
1. Untreated control	-	-	-	-	-	-	-	-	-
2. Spectrum	1.4	00-03	70	0	90	100	100	0	0
3. Stomp Aqua	3.0	00-03	80	70	90	80	80	0	0
4. Afalon 45 SC	3.0	00-03	90	80	90	0	0	0	0
5. Pulsar 40	1.25	00-03	0	0	0	0	0	0	0
6. Pulsar 40	1.0	00-03	0	0	0	0	0	0	0
7. Pulsar 40	1.0	16-18	90	70	80	90	90	55	70
8. Pulsar 40	0.75	16-18	70	50	60	85	70	30	60
9. Pulsar 40	0.5	16-18	50	30	40	75	50	0	50
10. Korum SL + Dash	1.25+ 0.625	16-18	90	80	85	90	90	70	80
11. Korum SL + Dash	1.0 + 0.5	16-18	80	70	70	80	70	55	70
12. Bazagran 480 SL Stratos Ultra	2.0 2.0	12-14 16-18	90	60	80	100	95	70	0
13. Bazagran 480 SL Stratos Ultra	1.0 2.0	12-14 16-18	85	40	60	100	90	50	0

Afalon 45 SC indicated relatively good effect against the annual broadleaf weeds in comparison with the other weed species. At the soil application of Pulsar 40, regardless of the used rates, the worst efficacy were obtained. As opposite to the soil application, at the foliar aplication relatively good results were obtained. After the decreasing of the herbicides rates, the efficacy was also diminished. At the separate treatments with Basagran 480 and SL Stratos Ultra sufficient efficacy agauinst fat-hen and barnyard grass was reported. The efficacy against Bottlegrass was absolute. The lowest herbicide effect was recorded against knotgrass, scented mayweed and field bindweed. The herbicide Bazagran 480 SL had no effect against the weed yuncker (Table 2).

The obtained data from the visual observations by the 9 score scale of EWRS showed that the studied rates of the soil applieble herbicides Spectrum, Stomp Aqua and Afalon 45 SC were selective for the checkpea variety and did not depress plant growth and development (Table 3). After the soil application of Pulsar 40 at all rates phytotoxicity did not appear, but at the three rates of Pulsar 40 apllied during the growth stages (BBCH 16-18) phytotoxicity was reported - score from 1 to 3. Our results coresponded with the data reported by Vasilakoglou et al. (2013) where the imazamox caused visible injury expressed as stem and leaf chlorosis,

as well as chickpea yield was significantly reduced. For the other treatments applied during the vegetation, different level of phytotoxicity expessed in growth retardation, followed by chlorosis and necrosis of the chickpea plants was observed. Higher score of phytotoxicity was found at Korum SL + Dash and Bazagran 480 SL + Stratos Ultra - score ftom 5 to 7. This was probably due to the active substance bentazon, that was extremely aggressive to the chickpea. That corresponds with results from a study conducted by Plew et al. (1994) where the chickpea plants did not tolerate postemergence applications of bentazone. The phytotoxicity obsereved on the 14th day after the treatments was not overvomed and kept to the end of the vegetation.

Table 3. Phytotoxicity of the herbicides by the scale of EWRS at chickpea

Var. № Herbicides	Rate l/ha	Phenophase (BBCH)	Score	
			7 days after treat-ments	14 days after treat-ments
1. Untreated control	-	-	-	-
2. Spectrum	1.4	00-03	0	0
3. Stomp Aqua	3.0	00-03	0	0
4. Afalon 45 SC	3.0	00-03	0	0
5. Pulsar 40	1.25	00-03	0	0
6. Pulsar 40	1.0	00-03	0	0
7. Pulsar 40	1.0	16-18	3	1.5
8. Pulsar 40	0.75	16-18	2	1
9. Pulsar 40	0.5	16-18	1	1
10. Korum SL + Dash	1.25+ 0.625	16-18	6	6
11. Korum SL + Dash	1.0 + 0.5	16-18	5	5
12. Bazagran 480 SL Stratos Ultra	2.0 2.0	12-14 16-18	7	7
13. Bazagran 480 SL Stratos Ultra	1.0 2.0	12-14 16-18	5	5

Conclusions

Afalon 45 SC showed higher herbicide efficacy against fat-hen (*C. album* L.) and knotgrass (*P. aviculare* L.) in comparison with the efficacy of Stomp Aqua and Spectrum. The herbicide product Spectrum showed excellent efficacy (100 %) against bottlegrass (*S. viridis*) and barnyard grass (*E. crus-galli* L.). At none of the soil applied herbicides efficacy against field bindweed (*C. arvensis* L.) and yuncker (*C. campestris* Yunck.) was recorded. The herbicides Afalon 45 SC, Stomp Aqua and Spectrum were exclusively selective for the chickpea variety „Plovdiv 8". At all studied rates of the herbicide apllied during the vegetation in phenophase BBCH 16-18, phytotoxicity on different level was reported – score from 1 to 3.

The highest herbicide efficacy was obtained at the variant treated with Korum SL + Dash at rate of 1.25 + 0.625 l/ha, but high level of phytotoxicity wiht score 6 was observed.

After the treatment with Basagran 480 SL at rate 2 l/ha, followed by Stratos Ultra at rate 2 l/ha the highest phytotoxicity for the crop was established – score 7.

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