Effect of Seed's Age on Some Treatments' Efficiency for Breaking of Dodder (*Cuscuta campestris* Yunck.) Seed's Dormancy.

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Abstract- The experiment was conducted in Kahramanmaraş Sütcü Imam University, in the laboratory of the plant protection department, Faculty of Agriculture. On 14 Feb 2020 to 27 Feb 2020. The experiment tested 8 treatments (chemical and biological) using seeds from three different ages. Dodder (*Cuscuta campestris*) seeds were planted in Petri dishes by using double filter paper (Whatman Filter paper) where 30 dodder seeds were put in each Petri for each treatment in CRD design with three replications. The results showed the superiority of seeds aged one-year over seeds aged two-year and seeds aged three-year in germination test values, where it recorded 26.81% for the seed germination percentage, 1.81 for the speed of germination, 4.95 for the mean germination time, 0.67 for the mean daily germination, 0.14 for the peak value, and 0.12 for the germination Value. H2SO4 treatment recorded the highest germination percentage reached 34.81% followed by 25.56% in KNO3 treatment. The speed of germination was recorded the highest value reached 2.55 for H2SO4 treatment. The mean germination time in seed recorded the maximum 6.06 for H2SO4 treatment. The mean daily germination has recorded a maximum of 0.87 for H2SO4 treatment followed by 0.64 for KNO3 treatment. The peak value was observed a maximum of 0.17 in H2SO4 treatment followed by KNO3, gibberellic acid, and indole butyric acid treatments where it recorded 0.15, 0.13, and 0.13 respectively. The germination value has recorded a maximum of 0.16 for H2SO4 treatment and a minimum of 0.01 for control. The interaction between the seed's age and the different treatments impacted on the seed germination test values, where the interaction of the seeds aged one-year with the treatment of H2SO4 recorded the highest germination percentage reached 60%, while the Speed of germination was recorded the highest value reached 4.95 for the interaction of seeds aged one-year with the treatment of H2SO4. The mean germination time in seed recorded a maximum of 9.94 for the interaction of the seeds aged one-year with the treatment of H2SO4. The mean daily germination was recorded maximum value reached 1.50 for the interaction of the seeds aged one-year with the treatment of H2SO4. The peak value was observed maximum in the interaction of the seeds aged one-year with the treatment of H2SO4 reached 0.22. The interactions of seeds aged one-year with the treatments of H2SO4 recorded the highest germination value reached 0.34.

Index Terms- Dodder, Dormancy, Efficiency, Seeds, Turkey

I. INTRODUCTION

Dodder (*Cuscuta campestris* Yunck.) is one of the Dodders (*Cuscuta spp*.) that belongs to Convolvulaceae family. There are more than 200 species and over 70 varieties of dodders (*Cuscuta spp*.) throughout the world [2], all of them a holoparasite weed get all of its food and nutrients from a host plant. There are 55 plant hosts of *C. campestris* that were identified in Anatolia region, 27 of them are Cultivated crops, the most common being are Eggplant, Beetroot, Alfalfa, Clover, Faba bean., Pepper, Onion, Carrot., Anise, Caraway, Tobacco, Common vetch, Chickpea, Asparagus, Grapevine, Melon, Potato, and Tomato [12,15]. It is reported that *C. campestris* caused significant damages to sugar beet, eggplant, carrot, pepper, garlic, onion, tomato, legumes, melon, watermelon, potato, and clover, the damage ranges between 50-90% according to the crop type in the absence of control measures [4, 8, 9, 11]. In Iraq was reported 64.11% eggplant yield reduction caused by *C. campestris* [1]. In USA conditions, it has been reported that alfalfa yield decreased 57% caused by *C. campestris* [4]. It has been determined that *C. campestris* caused a 63% decrease in sugar beet seed yield and 18.7-55.4% in sugar content [13]. In India, *C. campestris* caused significant losses in some crop yields reached 60-65% in red pepper, 86% in chickpeas, 60-70% in clover and 87% in lentils [10]. Some researchers reported that the one of dodder plant can produce 2000 seeds per year [10], and other researcher reported that this number may be up to 3,000 - 25,000 seeds per year [15]. It's pretty hard to control dodder species effectively because its seeds have a hard seed coat, as well as it has the potential to remain viable in the soil for many years [10]. An important factor for dodder's success as a parasite is seed dormancy, whereas many studies reported that seeds dormancy period in dodder may for up to 50 years or more [1, 2]. Under field conditions, dodder seeds can remain dormant for more than ten years, when the dormancy is broken the dodder seeds immediately germinate on optimal temperature and humidity [10]. The agricultural lands that contaminated by dodder contain a large stock of seeds, which required an integrated approach to mitigate this stock, accordingly, it's important to study breaking dormancy of seeds to reduce seed banks in the soil and reducing the damage of dodder in cultivated fields. This study aims to investigate the effect of seed's age in the

efficiency of some treatments in breaking the seed dormancy of *C. campestris*.

II. MATERIALS AND METHODS

Dodder seeds were collected within 3 years in October 2017, 2018, and 2019 from agricultural lands of East Mediterranean Cross Region Agricultural Research Institute in Turkey. The experiment was conducted in the plant protection laboratory of Sütcü Imam University, Kahramanmaraş State, Turkey. The germination study of *Cuscuta campestris* was conducted at 25°C. Dodder seeds have been used in three different ages, and within each age, the dodder seeds were treated with the following treatments:

A. Submerging seeds in sulfuric acid (H2SO4 98%) for 10 minutes, then washing it with running water for 5 minutes.
B. Submerging seeds in potassium nitrate (KNO3 0.2%) for 24 hours, then washing it with running water for 5 minutes.
C. Submerging seeds in gibberellic acid (200 ppm) for 20 minutes.
D. Submerging seeds in indole butyric acid (200 ppm) for 20 minutes.
E. Submerging seeds in normal water for 24 hours.
F. Submerging seeds in hot water (80°C) and left it in water until it cools off.
G. Cooling seeds at (2°C) for 10 days.
H. Control (not treating the seeds with any treatment).

On date 14 Feb 2020, dodder seeds were planted in Petri dishes by using double filter paper (Whatman Filter paper) where 30 dodder seeds were put in each Petri dish in three replications for each treatment in a completely randomized design (CRD). Where the germinating dodder seeds had calculated in 12 days except for planting day and the following day. The water requirement of Petri dishes was daily given about five milliliters to each Petri dish. The following indications were calculated:

1. Seed germination percentage (GP) was calculated according to [7] using the following way: Germination % =Number of germinated seeds / Total number of seeds × 100.
2. Speed of germination (SG) was calculated according to [7] using the following way: Speed of germination = n1/d1+n2/d2+n3/d3+-----

Note, n = Germinated seed's number, d= Day's number.

3. Mean germination time (MGT) was calculated according to [5] using the following way: MGT = n1 x d1 + n2 x d2 + n3 x d3 + --------/ Total number of days. Note: n= Germinated seed's number.
4. Mean daily germination (MDG) was calculated according to [7] using the following way: MDG = Total number of germinated seeds/ Total number of days.
5. Peak Value (PV) was calculated according to [7] using the formula: PV = Highest seed germinated/ Number of days.
6. Germination Value (GV) was calculated according to [7] using the following way: GV = PV X MDG.

Collected data were analyzed using SPSS and analysis of variance (ANOVA) at 1% level of probability.

III. RESULTS AND DISCUSSION

Through the conduct of germination tests on dodder seeds, it turns out that there were differences in germination tests values, these differences related to seed's age and treatments at the same time which clear as the following:

A. The effect of seed's age on breaking of dodder seed's dormancy:

The results of data analysis showed differences in germination test values according to the seed's age as the table (1). The seeds aged one-year surpassed the seeds aged two-year and three-year in terms of germination percentage, where it recorded 26.81%, 14.86%, and 10.97% respectively. Also, the speed of germination in seeds aged one-year was higher than other age groups, where it recorded 1.81, 0.84, and 0.49 for the seeds aged one-year, two-year and three-year respectively. Along similar lines, the Mean germination time has recorded a maximum of 4.95 in seeds aged one-year followed by 2.81in seeds aged two-year and a minimum of 2.20 in seeds aged three-year. The mean daily germination in seeds at different seed's age varied from the minimum 0.27 for seeds aged three-year topped by 0.37 for seeds aged two-year to the maximum 0.67 for seeds aged one-year. The peak value was noticed a maximum of 0.14 in seeds aged one-year followed by 0.11in seeds aged two-year and a minimum of 0.10 in seeds aged three-year. Regarding germination percentage, speed of germination, mean germination time, mean daily germination, and peak value the differences across the seed's age were statistically highly significant at 0.01% level. The seeds aged one-year surpassed the seeds aged two-year and three-year in terms of Germination value where it recorded 0.12, 0.04, and 0.03 respectively, the difference in germination value was statistically highly significant at P<0.001 significance level for seeds aged one-year, whereas, has been found non-significant differences between the seeds aged two-year and three-year at P<0.001 significance level.

Table (1) shows data about germination test values according to the seed's age:

Seed's Age	GP %	SG	MGT	MDG	PV	GV
Seeds aged one-year	26.81^{a}	1.81^{a}	4.95^{a}	0.67^{a}	0.14^{a}	0.12^{a}
Seeds aged two-year	14.86^{b}	0.84^{b}	2.81^{b}	0.37^{b}	0.11^{b}	0.04^{b}
Seeds aged three-year	10.97^{c}	0.49^{c}	2.20^{c}	0.27^{c}	0.10^{c}	0.03^{b}
LSD at 0.01	1.67	0.28	0.49	0.04	0.03	0.02

Values followed by the same letter(s) in the same column are not significantly different from each other at 0.01 level of probability. **GP % =** Seed germination percentage, **SG =** Speed of germination, **MGT =** Mean germination time, **MDG =** Mean daily germination, **PV =** Peak Value, **GV =** Germination Value.

B. The effect of the different treatments on breaking of dodder seed's dormancy:

According to data analysis and values shown by the table (2). All treatments outperformed the control in the percentage of germination. H2SO4 treatment recorded the highest germination percentage reached 34.81% followed by 25.56% in KNO3

treatment, the differences between the H2SO4 and KNO3 treatments were significantly at P<0.001 significance level, whereas the treatments gibberellic acid and indole butyric acid recorded 20% and 18.89% germination percentage respectively and the differences between them were not significant at P<0.001 significance level. As well as the treatments of water immersion and Cooling recorded germination percentage of 12.96% and 13.70% respectively and the differences between them were not significant at P<0.001 significance level. The lowest percentage of germination was in the hot water treatment where it was recorded at 9.63%. The speed of germination was recorded highest value reached 2.55 for H2SO4 treatment and the lowest value reached 0.34 for hot water treatment and the differences between H2SO4 treatment and other treatments were significant at P<0.001 significance level. The mean germination time in seed at different treatments varied from the maximum 6.06 for H2SO4 treatment to the minimum 1.18 for control and the difference between the H2SO4 treatment and all the treatments was statistically highly significant at P<0.001 level. The lowest mean germination times in seed were in treatments of hot water and cooling were recorded 2.21 and 2.47 respectively and the differences between them were not significant at P<0.001 significance level. Similarly, the mean daily germination has recorded a maximum of 0.87 for H2SO4 treatment followed by 0.64 for KNO3 treatment and a minimum of 0.12 for control. Differences in mean daily germination between H2SO4 treatment and other treatments were statistically highly significant at P<0.001 significance level, as well as the mean daily germination, has recorded 0.50 and 0.47 respectively for gibberellic acid and indole butyric acid treatments, differences between them were statistically not highly significant at P<0.001 significance level. The peak value was observed maximum in H2SO4 treatment and the differences between it and the treatments of KNO3, gibberellic acid and indole butyric acid statistically not highly significant at P<0.001 significance level, were recorded 0.17, 0.15, 0.13, and 0.13 for these treatments respectively, and minimum 0.08 in the control. The germination value was recorded a maximum of 0.16 for H2SO4 treatment and a minimum of 0.01 for control and the differences in germination value between H2SO4 treatment and other treatments were statistically highly significant at P<0.001 significance level, while the treatments of water immersion, hot water, and cooling were recorded 0.03 for every one of them and the differences between them were statistically not highly significant at P<0.001 significance level.

C. The effect of interaction between the seed's age and the different treatments on breaking of dodder seed's dormancy:

Table (3) shows the results of the interaction between the seed's age and the different treatments on the seed germination test values. Regarding the seed germination percentage, the interaction of the seeds aged one-year with the treatment of H2SO4 followed by the interactions of seeds aged one-year with KNO3, gibberellic acid, indole butyric acid, and seeds aged two-year with H2SO4, where it recorded 60%, 45.56%, 31.11%, 27.78%, and 26.67% respectively. The Speed of germination was recorded the highest value reached 4.95 for the interaction of seeds aged one-year with the treatment of H2SO4 followed by the interactions seeds aged one-year with the treatments KNO3, gibberellic acid, and seeds aged two-year with H2SO4 were recorded 3.24, 2.29, and 1.96 respectively, and lowest value reached 0.10 for the interaction of seeds aged two-year with control. The mean germination time in seed at different interactions varied from the maximum 9.94 for the interaction of the seeds aged one-year with the treatment of H2SO4 followed by the interactions of seeds aged one-year with KNO3, gibberellic acid, indole butyric acid, and seeds aged two-year with H2SO4, where it recorded 8.19, 5.64, 5.53, and 4.75 respectively, and the minimum 0.89 for the interaction of seeds aged two-year with control. Although mean daily germination was recorded maximum value reached 1.50 for the interaction of the seeds aged one-year with the treatment of H2SO4 followed by the interactions of seeds aged one-year with KNO3, gibberellic acid, indole butyric acid, and seeds aged two-year with H2SO4, where it recorded 1.14, 0.78, 0.69, and 0.67 respectively, and the minimum value reached 0.08 for the interaction of seeds aged two-year with control. The peak value was observed maximum in the interaction of the seeds aged one-year with the treatment of H2SO4 reached 0.22, and the minimum value reached 0.08 for the interaction of seeds aged two-year with control. Regarding germination value, the interactions of seeds aged one-year with the treatments of H2SO4, KNO3, gibberellic acid, indole butyric acid, and seeds aged two-year with H2SO4 treatment showed significantly different from the lesser value which was the interaction of seeds aged two-year with control treatment at 0.01 level of probability, where it recorded 0.34, 0.22, 0.13, 0.13, 0.09, and 0.01respectively, while the other interactions showed no statistically, differences from the interaction of seeds aged two-year with control treatment at 0.01 level of probability.

Table (2) shows data about germination test values according to the treatments:

Treatments	GP %	SG	MGT	MDG	PV	GV
H2SO4	34.81^{a}	2.55^{a}	6.06^{a}	0.87^{a}	0.17^{a}	0.16^{a}
KNO3	25.56^{b}	1.54^{b}	4.64^{b}	0.64^{b}	0.15^{ac}	0.11^{b}
Gibberellic Acid	20.00^{c}	1.25^{bcf}	3.86^{bc}	0.50^{c}	0.13^{abcd}	0.07^{bc}
IBA	18.89^{c}	1.00^{cdf}	3.60^{c}	0.47^{c}	0.13^{abcd}	0.07^{ce}
water immersion	12.96^{df}	0.73^{de}	2.53^{de}	0.32^{df}	0.09^{bed}	0.03^{d}
Hot water	9.63^{e}	0.34^{eh}	2.21^{e}	0.24^{e}	0.11^{cd}	0.03^{d}
Cooling	13.70^{f}	0.80^{f}	2.47^{e}	0.34^{f}	0.09^{d}	0.03^{de}
Control	4.81^{h}	0.15^{h}	1.18^{f}	0.12^{h}	0.08^{d}	0.01^{d}
LSD at 0.01	2.72	0.45	0.80	0.07	0.05	0.04

Values followed by the same letter(s) in the same column are not significantly different from each other at 0.01 level of probability. **GP %** = Seed germination percentage, **SG** = Speed of germination, **MGT** = Mean germination time, **MDG** = Mean daily germination, **PV** = Peak Value, **GV** = Germination Value.

Table (3) shows data about germination test values according to the interaction between the seed's age and the treatments:

Seed's age	Treatments	GP%	SG	MGT	MDG	PV	GV
Seeds aged one-year	H2SO4	60.00**	4.95**	9.94**	1.50**	0.22**	0.34**
	KNO3	45.56**	3.24**	8.19**	1.14**	0.19**	0.22**
	Gibberellic Acid	31.11**	2.29**	5.64**	0.78**	0.17**	0.13**
	IBA	27.78**	1.41**	5.53**	0.69**	0.19**	0.13**
	water immersion	18.89**	1.07**	3.72**	0.47**	0.08**	0.04
	Hot water	12.22**	0.40	2.97**	0.31**	0.11**	0.03
	Cooling	12.22**	0.86**	2.03**	0.31**	0.08**	0.03
	Control	6.67**	0.23	1.56**	0.17**	0.08**	0.01
Seeds aged two-year	H2SO4	26.67**	1.96**	4.75**	0.67**	0.14**	0.09**
	KNO3	17.78**	0.76	3.42**	0.44**	0.11**	0.05
	Gibberellic Acid	16.67**	1.03**	3.17**	0.42**	0.11**	0.05
	IBA	17.78**	0.74	3.53**	0.44**	0.11**	0.05
	water immersion	13.33**	0.91**	2.19**	0.33**	0.11**	0.04
	Hot water	7.78**	0.25	1.83**	0.19**	0.11**	0.02
	Cooling	15.56**	0.97**	2.72**	0.39**	0.11**	0.04
	Control	3.33	0.10	0.89	0.08	0.08	0.01
Seeds aged three-year	H2SO4	17.78**	0.75	3.50**	0.44**	0.14**	0.06
	KNO3	13.33**	0.63	2.31**	0.33**	0.14**	0.05
	Gibberellic Acid	12.22**	0.43	2.78**	0.31**	0.11**	0.03
	IBA	11.11**	0.85**	1.75**	0.28**	0.08**	0.02
	water immersion	6.67**	0.21	1.67**	0.17**	0.08**	0.01
	Hot water	8.89**	0.35	1.83**	0.22**	0.11**	0.03
	Cooling	13.33**	0.57	2.67**	0.33**	0.08**	0.03
	Control	4.44	0.14	1.08	0.11**	0.08**	0.01
LSD at 0.01		4.7	0.779	1.38	0.11	0.067	0.067

(**) Significantly different from the lesser control value (Seeds aged two-year* control) at 0.01 level of probability.
GP % = Seed germination percentage, **SG** = Speed of germination, **MGT** = Mean germination time, **MDG** = Mean daily germination, **PV** = Peak Value, **GV** = Germination Value.

IV. CONCLUSION

The seed's age in dodder plays an important role in the ability of the dodder's seeds to germinate, as it was found that the dodder's seeds aged one-year are more capable of germination and therefore they are a major source of infection for the fields planted with crops, that was probably because the seeds are newly formed and did not enter the second stage of dormancy. Pre-planting germination of dodder's seeds is technologically achievable by using some treatments and the most effective is H2SO4 at 98% followed by treatments of KNO3 at 0.2%, gibberellic acid at 200 ppm, indole butyric acid at 200 ppm.

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REFERENCES

[1] Bashar K. H. Al-Gburi, Fadhil H. Al-Sahaf, Fadhal A. Al-Fadhal, Juan P. Del-Monteb, Evaluation of different treatments on break seed dormancy of Dodder (Cuscuta campestris Yunck" Journal of Research in Weed Science 2 (2019) 168-179.

[2] Costea M, Tardif F.J. 2004. Cuscuta (Convolvulaceae), the strength of weakness; a history of its name, uses and parasitism concept during ancient and medieval times. Sida. 21: 369-378.

[3] Czabator, F. J. 1962. Germination value: An index combining speed and completeness of pine seed germination. Forest Science 8: 386 – 395.

[4] Dawson, J.H., Musselman, L.J., Wolswinkel, P. ve Dorr, I. 1994. "Biology and control of Cuscuta", Rev. Weed Science, 6:265–631.

[5] Ellis, R. H. and E. H. Roberts 1981 . The quantification of ageing and survival in orthodox seeds. Seed Sci. Tech. 9: 373-409.

[6] Ibraheem M. Aliyas, Muhammed A. Ahmed, Muhammed Y. Ali. 2014. Germination Response of Dodder Seeds with Some Agricultural crops Seeds in Laboratory Conditions. International Journal of Scientific and Research Publications, Volume 4, Issue 6, June 2014 1 ISSN 2250-3153.

[7] ISTA. 1999. International rules for seed testing. *Seed science and Technology,* 21:288 pp.

[8] Lanini, W. T. Kogan M., 2005. "Biology and Management of Cuscutain Crops", Ciencia E Investigation Agraria, Vol: 32(3) 165-179.

[9] Lian, J.Y., Ye W.H., Cao, H.L., Lai, Z.M., Wang, Z.M., Cai, C.X., 2006. "Influence of obligate parasite *Cuscuta campestris* on the community of its host Mikania micrantha", Weed Research, 46, 441-443.

[10] Mishra, J. S. 2009. "Biology and management of Cuscuta species". Indian Weed Sci., 41: 1-11.

[11] Nadler-Hassar, T., ve Rubin, B. 2003. "Natural tolerance of *Cuscuta campestris* to herbicides inhibiting amino acid biosynthesis", Journal of Weed Research, 43(5),341-347.

[12] Nemli, Y. Kaya, İ. Tamer, Ş. R. 2015. "A parasitic invasive plant: *cuscuta campestris* yunck. İstilaci parazit bir bitki: *cuscuta campestris* yunck", İstilacı Bitkiler Çalıştayı/Invasive Plants Workshop 22 Mayıs/May 2015.

[13] Nemlı, Y., 1986. "Anadolu'da Kültür Alanlarında Bulunan Küskút Türleri (*Cuscuta spp*.); Yayılışları ve Konukçuları Üzerinde Araştırmalar", Ege Üniversitesi Ziraat Fakültesi Dergisi, 23(3):11-21.

[14] Ustuner T, Cakir S. 2019. "Dormancy Breaking Studies of Dodder (Cuscuta spp.) was Problem in Greenhouse Tomato" The Eurasia Proceedings of Science, Technology, Engineering & Mathematics (EPSTEM), Volume 2, Pages 167-178.

[15] Üstüner, T., Öztürk, E. 2018. "Effect of dodder (*Cuscuta campestris* Yunc.) on yield and quality in sugar beet (*Beta vulgaris* L.) cultivation", Bitki Koruma Bülteni / Plant Protection Bulletin, 58 (1): 32-40.

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