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BIOLOGICAL PECULIARITIES OF CANADA THISTLE (CIRSIUM ARVENSE) AND ITS MECHANICAL CONTROLLING

Method of impoverishment, which is traditional in controlling of Canada thistle (Cirsium arvense) and involves repeated cutting of its overground parts, was not very effective because it is practically impossible to combine the process of rosette cutting with the process of its dehiscence. Consequently of such misfit open rosettes as a result of photosynthesis will replenish nutrients used by weed root system for sprouting from resting buds on the field surface. Vertical roots with lots of sucking roots will fill the lateral root system of Canada thistle (Cirsium arvense) with nutrients.

The last can be prevented by cutting the lateral roots from the central one with a subsoil cultivator at a depth of 18-20 cm. This technique provokes the appearance of great amount of rosettes on the field whose destruction by cultivators leads to complete destruction of the weed.

Introduction. At the present stage of the crop production branch development, the problem of weed control is worsened because they spread exponentially after simplifying the technology of their controlling. Minimizing of tillage contributes to this, in which the weed is completely controlled by using of chemicals. This also applies to controlling of perennial weeds and creeping-rooted weeds in particular.

The purpose of our research was to find out the reasons of relatively low efficiency of using the method of impoverishment in controlling of creeping-rooted perennial weeds and determine the ways to improve this method.

Materials and methods. Our study was based on a thorough analysis of the scientific literature which concerned the description of Canada thistle *(Cirsium arvense)* propensity to spreading and the factors that contribute to this process. Separately the recommendations of various scholars and our design for weed destruction by method of impoverishment. All the material is presented below as a result of our research.

Results and discussion. Among perennial weeds the creeping-rooted weeds are the most persistent. In the Forest-Steppe Zone they are: Canada thistle (Cirsium arvense), field sow thistle (Sonchus arvensis) and Cirsium setosum. Vegetative coming-up of Cirsium setosum was spreading into a flowerbed with a diameter of up to 6 m [1] for four summer months in accordance with the monograph "Weeds of Ukraine" edited in 1970, and according to the data of V.S. Tsykov, L.A. Matyuha and Yu.V. Lytvynenko a plant of Canada thistle (Cirsium arvense) within two years of growth formed a flowerbed of area of 10-11 square meters [2]. Therefore, weeds have ability of rapid spread on arable land. Good aeration of soil environment is the only condition for this because lateral roots are hardly formed for spreading in the compacted soil [3].

High propensity to spreading of these perennial weeds as thistles is accompanied by their making harm as well. Thus, in experiments of I.V. Lotonenko, N.I. Bukhalo and V.O. Skydan the presence of a plant of Canada thistle (Cirsium arvense) in crops of winter wheat per 1 square meter the productivity of food grains reduces by 3.6 hundreds kilograms per hectare on average for three years, then with the increasing of weed concentrations up to 3.5 and 10 pieces/square meter the yield capacity decreases to 6.0, 8.8 and 18.7 hundreds kilograms per hectare or by 10.9, 16.0 and 33.9% respectively [4].

The presence of Canada thistle (Cirsium arvense) in crops leads to wasteful spending of bioclimatic potential of agro-ecosystems. For example, under the complete absence of this weed the winter wheat spent 1045 units of water per unit of yield formation on average over three years

under the conditions of Kharkiv area, then on the crops, where the number of Canada thistle (Cirsium arvense) was 1, 3, 5 and 10 pieces per a square meter, this index was higher respectively by 12, 19, 30 and 69 % [4]. The same concerns the ground nutrition. There is evidence that at the presence of 5–10 sprouts of Canada thistle per a square meter in terms of hectare area the weed takes from the soil nearly 140 kg of nitrogen, 170 kg of potassium and 30 kg of phosphorus.

A well-developed plant of Canada thistle (Cirsium arvense) is capable to form up to 40 thousand of seeds that can be stored in the soil for 20 years and more without loss of its growing power. But the main method of Canada thistle reproduction is vegetative via root sprouts. This method is not doubtable, though among scientists that study Herbology there is no consensus in the vision of the individual details of the process of tillering.

It is generally accepted that on the field surface the root sprout appears from the reproduction bud which is located on the underground part of the plant, although reports of Yu.P. Manko, I.V. Veselovskyi, L.V. Orel and S.P. Tanchyk [5] indicate that sprouting from root instead of reproduction bud is typical for creeping-rooted weeds.

There are considerably more disagreements among scientists as to where the reproduction buds are located and from which depth they can provide a way out for sprouts to the surface. One group of researchers [2, 6, 7, 8, 9] and they are the majority consider that the buds may be located on both vertical deep roots and the lateral deep roots which are found in the topsoil parallel to the surface of the field. And these buds may sprout from different depths which may reach even 170 cm by separate reports. We can agree with all this but there is doubt as to the possibility of sprouting from such great depth. It is also doubtful that there is adequate storage of inulin in the vertical part of the root of Canada thistle (Cirsium arvense) for this. And its proof experimentally is impossible because thickness of the soil which sprout would get over will be destroyed while soil washing or digging.

Biological peculiarity of creeping-rooted weed and Canada thistle (Cirsium arvense) in particular is that on the soil surface the rosette of leaves are formed only at the growth of root sprout from buds from arable soil. And only such sprouts can contribute to the reproduction of weeds. If the seedling appears from the bud which was on vertical roots deeper than topsoil, then the seedling will only reproduce or renew the existing thistle plant according to the statement of L.N. Vereschahin and H.P. Fesenko [10] (and we support this statement), and not serve as a means of spreading (or reproduction) of weeds. And the number of buds that sprout from a vertical root as to the statement of M.P. Kosolap [8] is often very limited - within one or two.

If the great number of buds (reproduction and propagation) takes into account on the underground part of mature plant of Canada thistle (Cirsium arvense) it can be sure in high potency of this species of weed both to survive and spread but this potency cannot always be reality. There is indisputable fact that buds germination can be done by physical damage of overground and underground parts of vegetative plant but not accumulation of a sufficient quantity of nutrients in the root system. Some researches mention it [10] and connect the highest content of inulin in root system of thistle at the end of plant vegetation with autumn formation of new sprouts that provides surviving of root system during winter. Neither the first nor the second thought is without a reasonable basis because any of living organisms, whose winter-resistant level is greatly determined by the content of nourishment in its underground part, will use the nutrients accumulated during the vegetation period before winter to form new sprouts. In many cases they can die by exposure to low temperature during winter season because it will contradict ecological-coenotic strategy of the species.

Concerning the measures which assist in nutrients accumulation in the root system of Canada thistle (Cirsium arvense) we cannot agree with the statement of M.P. Kosolap [8, p.162] that paring with the aim to destroy vegetative mature weed plant is referred to these measures. In fact this action will stimulate the resting buds to germinate and root sprout to form. In this case nutrients will be used but not accumulated.

In scientific and academic literature on Herbology there are some contradictions concerning moistening influence of soil on germination intensity of the reproduction buds of Canada thistle

(Cirsium arvense). Thus, according to the publication of M.P. Kosolap [8] buds after paring (weed out of vegetative weed plant) cannot germinate at all under absence of moisture. But in other publication this author together with co-authors [10] show a contrary interpretation that content of moisture in soil does not affect the germination of resting buds. The authors of this article agree with the last fact and consider that this index can affect only the speed of appearance of root spouts on the field surface but this process can be longer because of the lack of moisture then with sufficient moistening of the soil.

There is some inaccuracy in special literature as to crumbling intensity of lateral roots of Canada thistle (Cirsium arvense) by disks can influence on viability of the root parts. Parts only with the length of 5[8], 3 [11] and even 1 [10] cm are considered as viable. Therefore, the root parts with the length of more than 5 cm will be nonviable. But it is not true because the number of reproduction buds on the longer parts will always be greater than on the shorter ones where the buds can be completely absent. To our minds, the authors naming such lengths of the parts took into account the minimum parameters of these parts when they can remain viable in the case of resting buds presence on them. It is of no use to pay attention on such parts because even modern agricultural implements are not practically able to crumble lateral roots into the parts less than 5 cm.

Some researchers do not connect viability of the root parts of Canada thistle (Cirsium arvense) with their length but only with buds presence or absence on them. Thus, V.F. Grodzynska [12] affirms that even parts of 5-8 mm can be viable if there are some buds. At the same time longer parts without buds cannot sprout. Besides the length of root part while planning the depth of inversion tillage should be taken into consideration which in many cases refers to the system of agro-technical measures to control creeping-rooted weeds. The longer root part is the greater depth is needed so that sprouts cannot grow up to the surface of the soil. They would be short of reserve nutrients in the root part. If even root parts short in length are remained in top soil during tillage, they will serve as a method of spreading of this weed.

Because of the ability of Canada thistle (Cirsium arvense) to vegetative propagation and the difficulty to control it this weed refers to the “problem” group [8]. However there is no problem to control thistle quantity among different agricultural crops having a great range of herbicides. Using mechanical means or, as most researchers call them agro-technical measures, makes operating this work more problematic. Among agro-technical measures there is the most efficient and effective one. It is tillage or which is more correct - a system of tillage because it is impossible to weed it out using only one measure. This system is based on using the method of impoverishment of creeping-rooted weeds which is recommended by scientists and traditionally applied practically for many years. This method consists in repeated cutting of overground part of creeping-rooted weed using subsurface cultivators, although desired effects are not received. Theoretically, frequency of cutting the rosettes of Canada thistle (Cirsium arvense) must be agreed with their becoming at the field that green leaves of rosette cannot fill up root system of the weed with plastic substance which was used for germination of resting bud and sprouting of root shoot on the surface. Even one day of open rosette existence is some number of assimilants which it formed and transferred to lateral roots. But it is practically impossible to follow this condition through different time of rosette becoming so the results of using this method will be negative in most cases. This happened in the experiment of one of the authors of this article. In this experiment during potato vegetation the rosettes of one weed were ruined in turn five times after daily remaining in light being open and the last rosette bloomed successfully before tubers gathering. Directing attention to this fact we conclude that this method does not impoverish a weed plant but the person who controls Canada thistle (Cirsium arvense).

Rotation approach of shallow and deeper measures of tillage was principally changed to control this weed successfully. If traditional system of tillage at the field with a great number of thistle plants started with shallower measures (shallow ploughing with disk means and repeated cultivation when thistle rosettes became on the soil surface) and finished with deeper unless deep measure (inversion tillage). That is why we offer to begin tillage with non-inversion mellowing with a subsurface cultivator after stubble paring. This agricultural implement must operate at a depth which is more below the level of thistle lateral roots with resting buds to cut it from feeding

vertical root which does not form sprouts by V.F. Grodzynska [12]. They will appear from lateral root later and not separately but in a great number as a plant reaction to such "surgical" operation made by human. Horizontal root with a few sucking roots which could nourish this part of the plant can be totally impoverished doing two or three cultivations to cut thistle rosettes. This method should be used in the system of fall tillage after winter and spring spicate grain crops with a long and warm period after gathering.

Offered method to control Canada thistle (Cirsium arvense) is less energy-consuming and cheaper in addition to high efficiency and provides considerable saving of fuel. Thus, fuel to do mellowing with a subsurface cultivator on a depth of 25 cm was used 30% less than to plough at the same depth.

Conclusions. The method of impoverishment in controlling of creeping-rooted weeds will be effective if at the very beginning the lateral (horizontal) thistle roots with resting buds are cut off from the main (vertical) root, and the rosettes appearing after this action in the field will be ruined by cultivation two or three times.

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Анотація

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Біологічні особливості осоту рожевого та як із ним боротись механічним способом

Загальноприйнятий метод виснаження, який рекомендується нині в боротьбі з коренепаростковими бур'янами і передбачає багаторазове підрізання розеток, виявився не зовсім ефективним, тому що при цьому процес підрізання розеток не узгоджується з процесом їх розкриття. Розкриті розетки в свою чергу за рахунок фотосинтезу будуть поповнювати запаси поживних речовин, витрачених кореневою системою бур'яну на вихід пагону зі сплячої бруньки на поверхню поля. Поновлювати бокову кореневу систему осоту рожевого поживою буде і вертикальний корінь з багатьма сисними корінцями. Останнє може попередити, відрізавши бокові корені зі сплячими бруньками від основного

вертикального під час плоскорізного обробітку на 18-20 см, виконаного після лущення стерні. Такий захід провокує появу на полі значної кількості розеток, знищення яких двох-трьохразовою культивацією приведе практично до повного знищення бур'яну.

Ключові слова: *осот рожевий, метод виснаження, комбінований зяблевий обробіток ґрунту*

Аннотация

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Биологические особенности осота розового и как с ним бороться механическим способом

Метод истощения, который является традиционным в борьбе с осотом розовым и предполагает многократное подрезание его надземной части, оказался не совсем эффективным, потому что практически невозможно процесс подрезания розетки совмещать с процессом их раскрывания. Вследствие такого несовмещения, раскрытые розетки в результате фотосинтеза будут восполнять запасы питательных веществ, израсходованные корневой системой сорняка на выход побега из спящей почки на поверхность поля. Восполнять боковую корневую систему осота розового питательными веществами будут и вертикальные корни с множеством сосущих корешков. Последнее можно предупредить, отрезав горизонтальные корни от центрального при помощи плоскорезной обработки на глубину 18 – 20 см. Такой прием провоцирует появление на поле множества розеток, уничтожение которых культиваторами приводит к полному уничтожению сорняка.

Ключевые слова: *осот розовый, метод истощения, комбинированная зяблевая обработка почвы*