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EFFECT OF IRRIGATION MODES, IRRIGATION METHODS, FERTILIZER RATES ON ONION YIELD

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У статті наведено результати досліджень з оптимізації технології вирощуванні цибулі при краплинному зрошенні. Встановлено, що для отримання врожайності культури на чорноземах супіщаних Південному Степу України на рівні 86-90 т/га, при ефективному використовуванні основних ресурсів інтенсифікації та природно-кліматичних умов рекомендується проводити поливи на краплинному зрошенні з таким розрахунком, щоб вологість ґрунту підтримувалася у перший період (від сходів до початку утворення цибулини) не нижче 90% НВ, в період наростання цибулини - 80% НВ. Під цибулю ріпчасту необхідно вносити добрива з розрахунку на врожайність 100 т/га.

Ключові слова: *цибуля ріпчаста, режими зрошення, способи поливу, ефективність використовування поливної води, дози добрив, продуктивність, врожайність.*

Лымарь А.О. Эффективность режимов орошения, способов полива, доз удобрений на урожайность лука репчатого

В статье приведены результаты исследований по оптимизации технологии выращивании лука при капельном орошении. Установлено, что для получения урожайности культуры на черноземах супесчаных Южной Степи Украины на уровне 86-90 т/га, при эффективном использовании основных ресурсов интенсификации и природно-климатических условий рекомендуется проводить поливы на капельном орошении с таким расчетом, чтобы влажность почвы поддерживалась в первый период (от всходов до начала образования луковицы) не ниже 90% НВ, в период роста луковицы - 80% НВ. Под лук репчатый необходимо вносить удобрения в расчете урожайность на 100 т/га.

Ключевые слова: *лук репчатый, режимы орошения, способы полива, эффективность использования поливной воды, дозы удобрений, продуктивность, урожайность.*

Formulation of the problem. Onion – one of the most common vegetable crops in Ukraine. The bulk of its cultivation is concentrated in southern regions, where soil and climatic conditions allow to obtain onions from seed. Sown area of onion in Ukraine vary between 30-40 thousand hectare, the average yield of 25-30 t/ha. Gross harvest of 920-930 thousand tons. Meanwhile, in this area there is a significant shortage of rainfall, which necessitates the use of artificial irrigation of vegetable crops to produce high yield.

Condition study of the problem. As demonstrated by international practice one of the most effective and economical way of watering is microirrigation. It virtually no effect on the soil and the environment negatively, allows reducing the cost of irrigation water, fertilizer, energy with simultaneous production of high-quality and high yield [1-3]. However, in Ukraine the issue of the development of elements of technology of cultivation of onions in the micro-irrigation systems in the conditions of southern steppe received little attention. Therefore, the study of new methods and modes of irrigation combined with the mineral nutrition for crops of onion is very urgent priority of research.

With irrigation of onion must be considered that the culture in low-developed root system is very demanding on the water. At the same time, it is sensitive to excessive moisture. With an excess of moisture it can get wet and damping-off. Especially onion demanding to the soil moisture in the first two weeks after planting, two or three weeks after germination, when leaves and root system are formed [4].

In the second half of vegetation bow less responsive to changes in soil moisture. Lack of moisture in the soil in the last third of the growing season is a prerequisite for a more rapid maturation of onions. At the same time, an excessive amount of moisture after the start of growth of leaves and their drying delays transition onion resting state thereby dramatically reduced storability of bulbs.

Tasks and methods of research. According to studies conducted by V. Y. Borisov, the best irrigation regime of onion comes with the support of the soil moisture in the layer 0-40 cm. At the level of 80-100% capillary fringe [5]. The research by Dudnik S. A. show the superiority of differential treatment of irrigation. Thus, the phase of emergence before the formation of bulbs soil moisture is maintained at 75-80% capillary fringe, and with the beginning of the phase of formation of the bulbs to the technical maturity of 65% capillary fringe. [6]

Results. Irrigation is important to plan a rational application of fertilizers taking into account the characteristics of the plant. As is known, the bow is very sensitive to the presence of nutrients in the soil. Thus, at 1 tone It uses commercial crop 2,5-5,4 kg. nitrogen, phosphorus and 1.1-1.7 1.7-4.5 kg potassium. According to research by Hodeev A. P. growth harvest onions on fertilizers is 66-70 kg/ha.

The aim of research was to develop the basic elements of the technology of growing onions in the micro-irrigation in the sandy soils of the south of Ukraine.

Experimental study of the effect of different agricultural practices on yield of onions in the micro-irrigation was performed during the 2008-2010 on the lands of the experimental farm of South State Agricultural Experimental Station of the Institute of Water Problems and Land Reclamation where was laid stationary three-factor field experiment.

Research carried out by the conventional method for vegetable crops. [7] Placing a systematic experimental plots, the total size of experimental area of 26 m^2, the size of the accounting area of 5 m^2, repeated 4 – single.

Soils pilot area – black southern black earth loamy, humus profile depth up to 77 cm., humus – 1.2-1.5%.

Preceded onion - tomato, recommended for this culture [8, 9]. Planting was carried out in the south of Ukraine regionalized varieties Chalcedony, under the scheme with the sowing of eight tapes (20+7 +7 +7+20+20+7+70 cm) rate of 6.0 kg/ha.

Watering is carried out by means of pipelines Evrodrip – under drip irrigation and elastic thick line with a system of nozzles micro sprinkling, according to a predetermined threshold of soil moisture.

The highest yield of onion in the studied years (2008-2010.) Was observed in the variant when watering micro sprinkling level preirrigation soil moisture 90-80-70% capillary fringe and the calculated level of mineral nutrition on the yield of 100 t/ha at the level of 90.53 m/ha. Several smaller yield was at variant with drip irrigation when soil moisture levels preirrigation 90-80-70% of the capillary fringe in the calculated level of mineral nutrition on the yield of 100 t/ha – 87.7 t/ha.

Comparing irrigation methods it can be concluded that in comparison with micro sprinkling drip irrigation yield increases by an average of 2.75 t/ha (4.8%) to the growth control was -3.6 times (Table 1).

Table 1 – Increase in the yield of onions, depending on the studied factors (average 2008-2010)

Irrigation methods	Irrigation regime	The level of mineral nutrition	Crop, t/ha	The increase in yield	
				t/ha	%
Without irrigation		Without irrigation	13,48	-	-
		calculation on 60 t/ha	18,56	+5,08	+37,69
		calculation on 80 t/ha	16,91	+3,43	+25,45
		calculation on 100 t/ha	17,00	+3,52	+26,11
Drip irrigation	80-70-70% capillary fringe	Without fertilizers	27,50	+14,02	+104,01 ,
		calculation on 60 t/ha	44,48	+31,00	+229,97
		calculation on 80 t/ha	66,86	+53,38	+395,99
		calculation on 100 t/ha	85,20	+71,72	+532,05
	90-80-70% capillary fringe	Without fertilizers	30,00	+16,52	+122,55
		calculation on 60 t/ha	47,68	+34,20	+253,71
		calculation on 80 t/ha	70,26	+56,78	+421,22
		calculation on 100 t/ha	87,70	+74,22	+550,59
Micro sprinkling	90-80-70% capillary fringe	Without fertilizers	33,94	+20,46	+151,78
		calculation on 60 t/ha	52,21	+38,73	+287,31
		calculation on 80 t/ha	73,15	+59,67	+442,66
		calculation on 100 t/ha	90,53	+77,05	+571,59
	80-70-70% capillary fringe	Without fertilizers	30,23	+16,75	+124,26
		calculation on 60 t/ha	46,47	+32,99	+244,73
		calculation on 80 t/ha	68,10	+54,62	+405,19
		calculation on 100 t/ha	87,01	+73,53	+545,47
LSD_{05} t/ha : A = 1,19; B = 1,46; C = 1,68.					

Increasing the level of mineral nutrition in the experiment increases the yield of onion. Thus, increasing the level of mineral nutrition per 60 t/ha, compared with the control, increases the yield in irrigated embodiments respectively of 17.3 t/ha (56.8%) 80 t/ha at 39.18 t/ha (128.8%), and at the level of 100 t/h – up to 57.2 t/ha, which is 188%.

The lowest average yield of onion during the years of the study was to form a natural moisture without fertilizers – 13.5 t/ha. The larger increase in yields has provided micro-irrigation mode 90-80-70% capillary fringe. Differentiated according to the phases of pre-irrigation moisture levels of the soil (80-70-70% capillary fringe) by reducing soil moisture on the phase of mass shoots in the beginning phase of the formation of bulbs has led to a decrease in yield of 3.7 t/ha.

Actual irrigation regime was formed during the years of studies depending on the method of watering, the soil level of pre-irrigation moisture and climatic conditions. On experimental plots the total water consumption was on the options in the natural moisture 3505 m^3/ha with drip irrigation, depending on preirrigation soil moisture levels ranged from 4481 to 4644 m^3/ha. And when micro sprinkling total water consumption by increasing irrigation rate increased from 4905 m^3/ha irrigation regime to 80-70-70% capillary fringe 5108 m^3/ha during the regime of 90-80-70% capillary fringe.

The lowest rates of water use efficiency for onions (Table 2) were obtained on variants with natural moisture (without irrigation). The most effective water at a drip irrigation with irrigation regime 90-80-70% capillary fringe and the calculated level of mineral nutrition on the yield of 100 t/ha.

Table 2 – Efficiency of use water by onion depending on the studied factors (average for 2008-2010)

Irrigation methods	Irrigation regime	The level of mineral nutrition	Average daily consumption m^3/ha	Coefficient of water consumption in m^3/t	Coefficient of efficiency of irrigation, m^3/t
Without irrigation		Without fertilizers	31,3	260,0	–
		calculation on 60 t/ha	31,2	188,8	–
		calculation on 80 t/ha	31,9	207,3	–
		calculation on 100 t/ha	33,1	206,2	–
Drip irrigation	80-70-70% capillary fringe	Without fertilizers	36,4	162,9	81,67
		calculation on 60 t/ha	35,6	100,7	44,17
		calculation on 80 t/ha	35,3	67,02	22,92
		calculation on 100 t/ha	35,0	52,6	16,79
	90-80-70% capillary fringe	Without fertilizers	37,1	154,8	78,87
		calculation on 60 t/ha	36,6	97,4	44,74
		calculation on 80 t/ha	35,7	66,1	24,42
		calculation on 100 t/ha	35,4	52,9	18,43
Micro sprinkling	90-80-70% capillary fringe	Without fertilizers	40,9	150,5	90,52
		calculation on 60 t/ha	40,2	97,8	55,03
		calculation on 80 t/ha	39,6	69,8	32,93
		calculation on 100 t/ha	39,0	56,4	25,19
	80-70-70% capillary fringe	Without fertilizers	39,5	162,2	99,52
		calculation on 60 t/ha	38,9	105,5	59,72
		calculation on 80 t/ha	38,4	72,0	32,56
		calculation on 100 t/ha	38,3	56,4	23,81

Analyzing the efficiency of the use of water on the embodiments with drip irrigation compared with identical embodiments when watering micro sprinkling (except variants without fertilizer), we can conclude that the drip irrigation method is more effective. The minimum water consumption rate indicators marked on the options with the regime irrigation 90-80-70% capillary fringe.

Fertilizer at the recommended doses contributed to a more efficient use of irrigation water than options where fertilizers were not brought at all. The increase rate of the estimated dose significantly reduces the water consumption of water per 1 ton of product.

Studies have determined the amount of nutrients that are consumed by plants to form the 10 tone of products. The analysis showed that during the regime of irrigation 90-80-70% capillary fringe formation 10 tons onion spent several smaller number of major nutrients than under the regime of irrigation 80-70-70% HB. For example, during the regime of 80-70-70% capillary fringe 10 tons bulbs consumed: Nitrogen – 45.5 kg; phosphorus – 12.51 kg; potassium – 22; while under the regime of 90-80-70% of nitrogen consumed capillary fringe – 43.7; P – 12.3; potassium – 21.0 kg.

On average, from experience on the irrigated variants onion carried out of the ground for the formation of 10 tons bulbs 44.6 kg of nitrogen; 12.4 kg of phosphorus and 21.5 kg potassium.

Following the observations of the development and spread of the root system of onion in this test at the time of the onset of technical maturity, we obtained the following data. With drip irrigation, the bulk of the roots in the area under irrigated line pipe in the layer 4-30 cm. And between the rows, where there was irrigation pipe in the layer 8-24 cm, some isolated roots extend to a depth of 50-55 cm. Thus in the aisle away from the roots of the series spread over a distance of 20 cm, some up to 25 cm. The bulk of them are in the 83-25 cm layer of the soil, the roots in the area of the butt aisles are not closed. At the same time, micro sprinkling roots appear at a depth of 3 cm. and distributed under the bulb to 37 cm. The bulk of their mass is in the area of a number of to a depth of 5-30 cm. Reaching the depth of 75 cm. In the aisle they are in the main its mass in a layer 10 to 17 cm. Micro sprinkling roots butt aisle are closed.

Based on these data we can conclude that when watering micro sprinkling compared to drip irrigation roots onion increasingly using zone between the rows, which creates favorable conditions for their growth. This in turn has a positive effect on productivity.

Conclusions. For the yield of onion in a loamy black earth South Steppe of Ukraine at the level of 86-90 t/ha, with a profitability of production of bulbs is not less than 165% and not more than the cost of onion 377 UAH/tone, at efficient use of key resources and the intensification of climatic Resources recommended conduct drip irrigation in such a way that soil moisture is maintained in the first period (from germination to the beginning of the formation of the bulb) is not below 90% capillary fringe, in a period of growth bulbs – 80% capillary fringe. And at maturity humidity is reduced to the level of 70% capillary fringe. The depth of the moisture under drip irrigation during the growing season, «young growth – the beginning of the formation of the bulb» is 20 cm, and in the interphase period of «onion growth and maturation» the depth of moisture must be at 30 cm (which formed the bulk of the root system of onion). Under the onion is necessary to make fertilizer per 100 t/ha.

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ЕНЕРГЕТИЧНА ЕФЕКТИВНІСТЬ ТЕХНОЛОГІЙ ВИРОЩУВАННЯ РІПАКУ ОЗИМОГО ЗА РІЗНИХ СПОСОБІВ ОБРОБІТКУ ҐРУНТУ ТА ДОЗ ВНЕСЕННЯ АЗОТНИХ ДОБРИВ

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У статті наведено результати трирічних експериментальних досліджень з вивчення впливу способів полицевого, безполицевого та диференційованого обробітку ґрунту, різних доз азотних добрив у ранньовесняне підживлення на урожайність та енергетичні показники ріпаку озимого. Максимальну врожайність насіння – 2,65-2,59 т/га одержано у варіанті оранки на глибину 25-27 см та чизельного розпушування на 14-16 см з щілюванням під попередню культуру на 38-40 см та за внесення азотного добрива у ранньовесняне підживлення дозою N_{100}. Результати енергетичної оцінки ефективності вирощування ріпаку озимого свідчать, що завдяки зниженню витрат на проведення чизельного розпушування на 14-16 см за дози азотних добрив N_{100} отримано максимальний енергетичний коефіцієнт 2,01.

***Ключові слова:** ріпак озимий, спосіб і глибина обробітку ґрунту, дози азотних добрив, енергетичні показники.*

Малярчук Н.П., Шепель А.В., Малярчук А.С. Энергетическая эффективность технологий выращивания рапса озимого при разных способах обработки и доз внесения азотных удобрений

В статье приведены результаты трехлетних экспериментальных исследований по изучению влияния способов отвальной, безотвальной и дифференцированной обработки почвы, различных доз азотных удобрений в ранневесеннюю подкомку на урожайность и энергетические показатели рапса озимого. Максимальную урожайность семян - 2,65-2,59 т/га получено в варианте вспашки на глубину 25-27 см и чизельного рыхления на 14-16 см со щелеванием под предыдущую культуру на 38-40 см и при внесении азотного удобрения в ранневесеннюю подкормку дозой N_{100}. Результаты энергетической оценки эффективности выращивания рапса озимого свидетельствуют, что благодаря снижению затрат на проведение чизельного рыхления на 14-16 см при дозе азотных удобрений $N1_{00}$ получен максимальный энергетический коэффициент 2,01.

***Ключевые слова:** рапс озимый, способ и глубина обработки почвы, дозы азотных удобрений, энергетические показатели.*