RELATION BETWEEN "ADDITIONAL YIELD - IRRIGATION DEPTH" OF ROOT CELERY

Harizanova – Petrova B.
Department of Melioration and Lang Surveying, Agricultural University – Plovdiv, 4000
e-mail: bilqna.harizanova@abv.bg

ABSTRACT

The aim of this study is to establish the parameters of the "Additional yield-irrigation depth" relationship for root celery in the region of Plovdiv. The experiment is carried out during 2010 – 2012 г. on alluvial – meadow, former waterlogged soil in the experimental fields of Agricultural University, Plovdiv. It used data of relative additional yield and relative irrigation depth with the following variants: 1) irrigation with 130 % of the irrigation rate (m); 2) irrigation with 100 % m; 3) irrigation with 70 % m; 4) irrigation with 50 % m; 5) irrigation with 30 % m; and 6) without irrigation. The irrigation rate is estimated to moisten the layer 0-0.40m, and maintain soil humidity higher than 80% of field capacity. Relation parameters are set by the degree formula: $\mathbf{Y=1-(1-x)^n}$, where **x** is the ratio between reduced and maximum irrigation depth, and **n** – exponent. The used formula is highly accurate in processing study data by swaths as well as for overall yields where the correlation coefficient R ranges from 0.990 to 0.998 and the degree indicator "n" varies from 1.15 to 1.58 (average – 1.5). Graphical dependence is expressed by a convex parabola.

Keywords: *celery, irrigation regime, yield-water relation*

INTRODUCTION

The cultivation of plants in a water deficit and establish their sensitivity to drought is extremely important for practice. Studies in this area enable optimizing the economic performance of the cultivation of the crop in terms of shortage of irrigation water. For this purpose it is a need to examine examine in yield in varying degrees of reduction of irrigation and evapotranspiration i.e. to establish the parameters of the "Water-Yield". In our country we have been similar developments in other crops, namely: Soybean, corn, sugar been, for grass mixture, sunflower, a damask rose, for vine planting material, for apple, green bean and other (A. Matev et al, 2014,2011,2013, 2001; Zh.Zhivkov and others. 2013; N. Lozanova and others. 2014; N.Nedkov et al., 2014; E.Tsvetanov al., 2015; Калайджиева Р. 2014). The analysis of the above literature shows that the sought dependence in studies cultures is expressed best through speed dependence, the exponent is usually less than 2 or ranges most often in the range of 1.2 to 2.0, depending on the culture and the nature of the year. The aim of the study is to establish the parameters of dependence "Additional production - irrigation rate" to headed celery grown in the region of Plovdiv.

MATERIAL AND METHODS

For the purpose of development used data from the field experiment conducted during the period 2010 - 2012 year at the Agricultural University - Plovdiv on alluvial-meadow soil. The experience is carried out by the method of long plots in

four replications with a size of experimental plots of 8.0 m2, and the harvest plots - 4 m2 in the scheme of planting of seedlings 70 +30 +30 +30 x 20 cm (5 plants of a meter). To establish the influence of irrigation regime on yield and quality of root celery production were set the following variants:

1) irrigation with 130 m % of the optimal irrigation application ;
2) optimal irrigation 100% m / 100% of the calculated irrigation rate m by soil moisture before irrigation up to 80% of field capacity in the depth 0-0,40m/;
3) irrigation with 70% m of the optimal irrigation application;
4) irrigation with 50% m of the optimal irrigation application;
5) irrigation with 30% m of the optimal irrigation application;
6) without irrigation.

The used drip irrigation system was with a distance between drippers 0.20m, distance between the two drip lines 0.60 m and discharge of the drippers q = 4l/hr in order to be given accurate and frequent irrigation applications. The size of irrigation application by different variants is determined by the optimal variant (100% m), which is calculated so that, the soil moisture before irrigation of the layer 0 – 0.4 m to be at least 80% of field capacity. The variants 1, 3, 4 and 5 were irrigated together with variant 2, but with appropriate adjustment to the irrigation rate. The harvest was performed on 143-147 days after planting seedlings. The parameters of the "Additional production - irrigation rate" are defined by the formula of David (1982, 1994) Y = 1- (1-x) n, where Y - additional yield, x - relative irrigation rate (the ratio between maximum and reduced irrigation rate M / Mo), and n - exponent. For the purpose used specialized computer program "YELD" David D. (1994) through which the output data are processed by least squares.

RESULTS AND DISCUSSION

The celery is a water loving culture and has a relatively long growing season, covers some of the driest and hottest months of the year - July and August. That is why her grows season is required under irrigation. The parameters of relationship between total yield and water deficiency on the productivity on weather conditions during the vegetation period, the most significant in this regard is the role of rainfall (quantity and distribution), temperature and humidity. The most favorable for growing celery is 2010 - wet and cool 2011's average, and 2012 - the worst - hot and dry. The results regarding the provision of the three main meteorological parameters are shown in Table 1.

Table 1. Provision of experienced year in terms of climatic factors N, T and d

Indicators		Година		
		2010	**2011**	**2012**
N	P (%)	13.3	60.0	90.0
T	P (%)	39.3	19.1	2.4
d	P (%)	69.2	38.5	7.7
*P – provision ; *N – rainfall; *T – temperature; *d-deficit of air humidity				

Parameters of the "Additional mining, irrigation rate"

The parameters of the relationship are defined, as for entity is accepted value for the norm and additional yield at variants who is produced maximum yield - var. 1. Relationship is depicted graphically in years and an average period in the figures 1 and 2. It is represented by prominent parabolas, which averaged experimental points in R> 0.95. The exponent ranges from 1.15 to 1.58 and the average for the three years is 1.5 (Table 2). It varies depending on the conditions of the year. The pace of the parabola is typical and indicative of the reaction of culture to varying degrees of securing water factors combined with the specific manifestation of the meteorological factors in three years. According to the graph maximum additional production and in the three years is accomplishment which is received at the maximum irrigation rate.

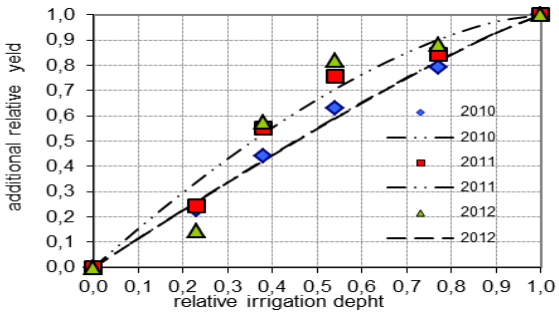

Fig.1. Additional yield – irrigation dept relationship by years, using equation $Y = 1-(1-x)^n$

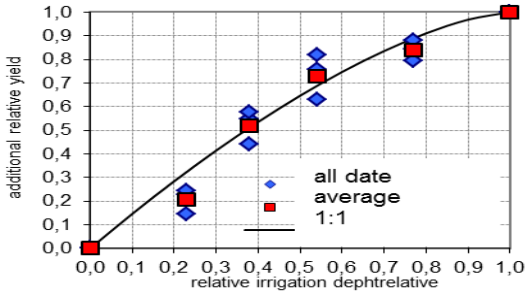

Fig.2. Additional yield – irrigation dept relationship by everage/total years, using equation $Y = 1-(1-x)^n$

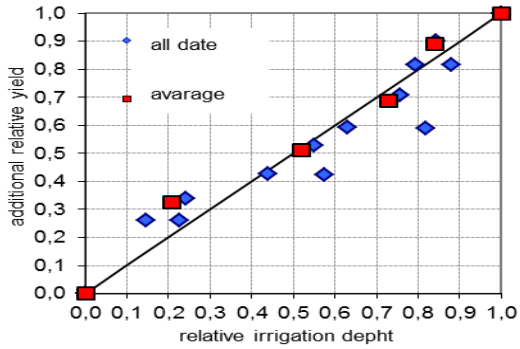

Fig.3. Relationship "experimental – calculated yield" by equation Y = 1-(1-x)^n

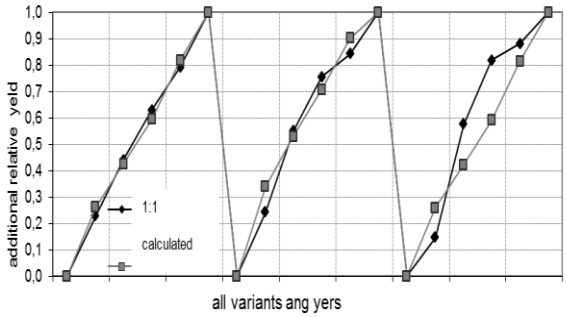

Fig.4. Experimental and calculated additional yield for all variants and years

Table 2. Parameters of relationship "Additional yield – irrigation dept"

year	2010	2011	2012	average	total
n	1.16	1.58	1.15	1.5	1.15
R	0.998	0.990	0.958	0.990	0.976

Table 3. Difference between experimental and calculated results use by yields

Year	Relative irrigation rate	Experimental data t /ha	Calculated t/ha	Y=1-(1-x)^n		
				± t/ha	%	± %
2010	0.00	4.77	4.77	0.00	100.0	0.0
	0.23	9.25	12.79	0.67	115.0	15.0
	0.38	13.44	16.90	-0.28	96.7	-3.3
	0.54	16.91	20.30	-0.71	94.3	-5.7
	0.77	20.38	23.43	0.51	103.3	3.3
	1.00	24.47	24.47	0.00	100.0	0.0
2011	0.00	2.66	2.66	0.00	100.0	0.0
	0.23	7.55	10.88	1.94	139.6	39.6
	0.38	13.75	15.08	-0.39	96.5	-3.5
	0.54	17.91	18.57	-0.99	93.5	-6.5
	0.77	19.68	21.77	1.18	106.9	6.9
	1.00	22.84	22.84	0.00	100.0	0.0
2012	0.00	0.59	0.59	0.00	100.0	0.0
	0.23	3.28	8.08	2.09	177.6	77.6
	0.38	11.18	11.92	-2.81	73.5	-26.5
	0.54	15.65	15.10	-4.19	72.2	-27.8
	0.77	16.80	18.02	-1.20	92.6	-7.4
	1.00	18.99	18.99	0.00	100.0	0.0
средно	0.00	2.67	2.67	0.00	100.0	0.0
	0.23	6.69	10.58	2.28	156.8	56.8
	0.38	12.79	14.63	-0.18	98.3	-1.7
	0.54	16.82	17.99	-0.78	94.5	-5.5

	0.77	18.95	21.07	0.96	105.9	5.9
	1.00	22.10	22.10	0.00	100.0	0.0

On the figures 3 and 4 are presented experimental and calculated yields and their relationship with R = 0.976. On the table 3 is presently the differences between the experimental and calculated using the formula yields. Independently that at smallest values deviations they are essential in the range of a real applicable irrigation regime (rate of 38 to 100%) the differences rarely exceed ± 10%. This approves applicability of the formula used to manage irrigation regime targets.

CONCLUSIONS

The relationship between additional yield and irrigation depth is represented successfully by the formula: $Y = 1-(1-x)^n$, were the degree exponent „n" is equal on 1.5 and varies by years from 1.2 to 1.6. R>0.95. Differences between the experimental and calculated using the formula amounts of additional yield from the same irrigation rateare not exceeding 10%. According to the established parameters of the relationship, the highest additional crop was obtained in variants with increased irrigated to hypothetically accepted for optimal irrigation rate. It necessary to revise the parameters determining the optimal irrigation regime in celery, which applies mainly to the amount of irrigation rate and depth of layers of soil to be moistened with irrigation.

REFERENCES

Goranov Hr..; Technique of irrigation as a tool of realization the regime of irrigation of corn and soybean; Dissertation, Sofia, 1977.

Davidov D., 1982; Relationship between "yield - water"; Hydraulic Engineering and Land Reclamation, Sofia., № 7;

Davidov D., St. Gaydarova, 1994; A computer program and database for the calculation of the project irrigation regime and the yield of agricultural crops; Notification on IHM, Volume XXIV.

Zhivkov Zh., A. Matev, 2013; Parameters of the "yield – irrigation rate" of sugar beet.; University of Forestry" – Sofia, Collection of reports "Theory and practice in agriculture ", p.291-302.

Kalaydzhieva R. 2014. Irrigation regime and evapotranspiration of green bean (Phaseolus vulgaris L. ssp. Nanus),variety STRIKE, for area of Plovdiv" Dissertation, Plovdiv, p. 211

Lozanova N., A . Matev, Zh. Zhivkov, R. Kalaydzhieva, 2014. Relationship between "additional yield - irrigation rate" of grass mixture of English ryegrass and red fescue. Science and Technology, IV, 6, 185 – 190.

Matev A., 2001. Relation between yield, evapotranspiration and irrigation rate on grain maize moderately late hybrid, Agricultural machinery, № 4, 39-43

Matev. A., Z. Chervenkova, G. Gotsis 2005. Relation between yield, evapotranspiration and irrigation rate on sugar beet; Agricultural machinery, № 4, 45-50.

Matev. A., R. Petrova, Hr. Kirchev, 2013. Parameters of the "additional yield -

irrigation rate" of sunflower of Plovdiv. Agricultural science, vol. VI, 15, 47 – 54.

Tsvetanov E., A. Matev, K. Kumanov. 2015. Calibration of models describing the "yield – irrigation rate" in micro irrigation vine plantation. Viticulture and Enology, 5, (14-19)

Matev, A., M. Gospodinova, 2011. Study on the parameters of the Yield-irrigation relationship in apple. Agrisafe final conference "Climate change: Challenges and opportunities in agriculture" Budapest – 2011, 320 – 323.

Nedkov. N, A. Matev, A. Ovcharova, 2014. "Additional Yield – Irrigation Depth" Relationship for White Bearing Rose (Rosa Alba L.). Ovidius University Annals Series: Civil Engineering, Issue 16, 91 – 104.Matev, A., R. Petrova, Hr. Kirchev, 2014. "Additional Yield–Irrigation Depth" Relationship Parameters for Soybean. Scientia Agriculturae, 5 (2), 61 – 66.

Matev, A., M. Gospodinova, 2011. Study on the parameters of the Yield-irrigation relationship in apple. Agrisafe final conference "Climate change: Challenges and opportunities in agriculture" Budapest – 2011, 320 – 323.

Nedkov. N, A. Matev, A. Ovcharova, 2014. "Additional Yield – Irrigation Depth" Relationship for White Bearing Rose (Rosa Alba L.). Ovidius University Annals Series: Civil Engineering, Issue 16, 91 – 104.