Application of Hose-Reel irrigation machine

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Abstract: In the presented contribution we evaluated the quality of work with a reel hose irrigation machine with rotating sprinkler, Komet 140 Twin. The aim of presented contribution was to evaluate the obtained results of sprinkle uniformity measuring for two reel hose Bauer Rainstar 85Tx irrigations machine. Measuring was realized on the lands of the agricultural company Agrocoop, Imel, a.s.. Value of the uniformity coefficient was determined according to standard STN ISO 7749-2. The number of rain gauge vessels was 30 (for first irrigation machine) and 39 (for second irrigation machine) and were spaced at a distance of 2 meters from each other. The value of uniformity coefficient according to Christiansen CU was 81.21 % (first irrigation machine) and 52.37 % (second machine). The first reel hose irrigation machine according to Klement and Heinige (CU more than 80 %) were achieved only first reel hose irrigation machine. The requirements according to standard STN ISO 7749-2 where CU has to be above 90% were unfulfilled neither of reel hose irrigation machines and not even namely after application of covering. The covering (to 8 m) was shown as effective for examined cases.

Key words: irrigation, coefficient of irrigation uniformity CU

Introduction

Regulation of the soil water schedule and the regulation of water situation for agricultural country has unsubstitutable place in all of soil management system. The watermanagement and the soil-climatic conditions in our place unsecured the appropriate conditions for economical utilization of widely delimited soil fund (Rehák, Novotný, 1996).

Intensity presents the water amount in **mm** supplied at time unit. Irrigation uniformity depends on correct running of irrigators (Látečka, 2000).

The first move for evaluation of the sprinkle uniformity is to obtain by measuring the set of irrigation rate values. Consequently, is possible to apply some of the known methods for evaluation quality of work for irrigation technology. Application of the irrigation rate was realizing after decrease of the actual soil moisture which will get under hydrolimit value of reduced access.

The measuring methods are divide according to that it is the irrigation with reel hose irrigation machines placed positional in spacing, irrigation with wide angle pivot reel hose irrigation machines or irrigation with reel hose irrigation machines (Látečka, 2000).

The fertigation and feeding of nutrients and fertilizers by irrigation water utilizing the basis of micro-irrigations, especially of drop irrigation. It is precise distribution of irrigation water; it is in precise amount and time, directly to localized root zone. Distribute also the dissolved nutrients and fertilizers at the same degree of uniformity distribution of irrigation water (Hríbik, 2009).

Materials andmethods

The practices measuring were resolved on the localized fields (fig.1). The company uses reel hose irrigation machines model Bauer Rainstar 90/300 (fig.2). Introduced company is situated on the south west Slovakia in Komárno region. Ground of the agricultural company is planar with sloping ranged 0 - 2°. Irrigator has available the sprinkle SR-101 with jet diameter 20 mm. The control of reel hose irrigation machine is securing with microcomputer Ecostar 4000. The sprinkle uniformity evaluation was progress on the parcel of land crop out potatoes. The reel hose irrigation machine was in conjunction with a tripod and far jet sprayer (figure 1). The basic parts of the machine are the following:

- 1 Basic sprinkler (frame, drum and control computer),
- 2 sensor for tube length and leading device,
- 3 supply hose,
- 4 PE tube- diameter 90 mm, length 300 m,

5 irrigation truck with sprayer.



Fig.1. Localized field



Fig.2. Irrigator Bauer Rainstar 85 TX Plus s Ecostar 4000, sprinkler SR101

For measurements of the uniformity of reel hose spray with tripod the applied methodology according to Standards norms. Set of values of irrigation doses according to norms of TNV 754307 (International Standard ISO 7749-2) is obtained in the precipitation measuring containers after one passing of the sprinkler. The machine in field testing must operate on flat terrain (maximum slope of 1%). Wind speed during the testing must not exceed 1.5m.s⁻¹. After determining the value of uniformity coefficient CU (%) the overlapping of the values of 4 m, 8 m and 16 m are applied.

The most extended is the method of sprinkle uniformity evaluation with uniformity coefficient CU according to CHRISTIANSEN from year 1942, in ZDRAŽIL and SPITZ (1966):

$$CU = 100. \left[1 - \frac{\sum_{i=1}^{n} |h_i - h_m|}{n.h_m} \right]$$
(1)

where h_i - rainfall high on the elementary surfaces (mm),

h_m – average high of the rainfall on the examined surface (mm),

n – number of the elementary surfaces, on which is the irrigated surface divided, at which the surfaces must be equal in size (ks),

$$\sum_{i=1}^{n} |\mathbf{h}_{i} - \mathbf{h}_{m}|$$
 - absolute sum of variance from average rainfall.



Figure 3 Spacing of measuring cups to one ray (rainfall cups, sprinkler, sprinkler movement direction)

Results and discussion

Practical measurements were made on the 16th June 2011 (irrigation machine 1) and 21th June 2011 (irrigation machine 2) in Agrocoop Imel, a.s. Before starting the practical exams, one of the sprinklers was chosen out, which we decided to test from the standpoint of the quality of work. The cups spacing was from 2 m. The maximal number of rainfall cups was 39. The position of the practice examination is presented on the fig. 3. The input values for evaluation of work quality for selected reel hose irrigation machines together with calculated value of uniformity coefficient according to Christiansen CU were introduced in the table 1.

The uniformity can be about 90% and also more (Steiner, 2001). The sprinkle uniformity and their evaluation belong to basic properties of irrigation quality (Simoník, 1998; Klementová and col., 2003A; Klementová and col., 2003B).

Frielinghaus (1992) confirmed it, he present as suitable uniformity the uniformity of Christiansen coefficient equal to 70 %.

Table T Spinikle uniformity, covering – 0								
Irrigation	Cups	aver Vi,	Sum Vi,	Sum Vi,	sum IVi-VI,			
machine	spacing, m	mm	ml	mm	mm	00, 7		
1	2	33,46	9800	1003,74	188,59	81,21		
2	2	12,06	4592	470,33	224,03	52,37		

Table 1 Sprinkle uniformity, covering = 0

May be establish that 75 % from the examined irrigators were obtained the satisfactory uniformity. It is needs to project proceeding with which is possible to obtain the increasing of the coefficient of uniformity CU. The covering of next irrigation belts is such as this proceeding, for example. The evaluation of sprinkle uniformity with covering is introduced in the table 2. The sprayer uniformity coefficient CU at zero overlap for irrigation machine 1 was 81.21 %. The sprayer uniformity coefficient CU at zero overlap for irrigation machine 2 was 82.37 %. The overlaps (4 m and 8 m) increase the value of coefficient uniformity.

Seriel number	Covering m	Sprinkle uniformity CU, %		
Serial number	Covering, m	Z1	Z2	
1	0	81,21	52,37	
2	4	87,01	54,06	
3	8	83,97	58,44	
4	16	79,54	74,66	

Table 2 Sprinkle uniformity by covering, Bauer Rainstar Tx85

Table.3 Descriptive statistic, measuring 2011, irrigation machines 1 and 2						
Devementer	Values					
Parameter	Irrigator 1	Irrigator 2				
Average value, mm	33,46	12,06				
Divergence max – min, mm	39,54	25,09				
Minimum, mm	8,19	0,51				
Maximum, mm	47,73	25,61				
Sum, mm	1003,74	470,33				
Number, ks	30,00	39,00				
Variation coefficient, %	25,31	60,00				

Descriptive statistic was introduced in the table 3 for measured irrigators. The average irrigation rate was not equal but ranged from 12.06 to 33.46 mm. The cups number in which was noted the irrigation rate was 30 pc. and 39 pc. Values of single irrigation rates were ranged from 8.19 mm to 47.73 mm. The variation coefficient was achieved the lowest value in the case of first irrigator (25.31 %). The graphical evaluation of results for first and second belt reel hose irrigation machines is on a fig. 4 and fig.5.



Figure 4. Irrigation rate, irrigation machine 1, covering 0, 4, 8 and 16 m, A-number of cups, B-irrigation depth, mm



Figure 5. Irrigation rate, irrigation machine 2, covering 0, 4, 8 and 16 m, A-number of cups, B-irrigation depth, mm

Conclusion

In this article we evaluated the work quality of Bauer Rainstar 85Tx reel hose irrigation machine. The value of the uniformity coefficient CuH is influenced by a number of external factors such as the shape of the irrigation curve, overlap and wind. Method by Christiansen (standard STN ISO 7749-2, 1999) was applied for evaluation. May be said on the basis of Růžička (1996) and Frielinghaus (1992) requests (value of the sprinkle uniformity coefficient over 70 %) that first reel hose irrigation machine was complied conditions. The covering selection is effective only to specific value because with the covering increasing decreases the work scope of reel hose irrigation machine.

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The report is reviewed.