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INFLUENCE OF AIR ASSISTANCE ON SPRAY COVERAGE OF WHEAT

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Abstract: The purpose of applying an additional air flux in field sprayers is limiting liquid drift. The flux also influences the quality of plant spraying. Air Plus Spridotrain sprayer, produced by RAU company, was applied in the research on the influence of air flux on the quality of coverage of winter wheat (Roma variety). The plant coverage was determined using water sensitive papers.

Key words: spraying quality, air assistance, air sleeve, coverage

I. INTRODUCTION

Field sprayers are equipped with air sleeves to limit liquid drift over the neighbouring fields. The drift is initiated by swirling air following the moving sprayer and is influenced by wind speed. An additional air flux is supposed to reduce the phenomenon of drift and, to a higher degree, neutralize the influence of weather conditions. It also influences the quality of plant spraying (Nordbo 1992; Nordbo et al. 1993; Nordby and Skuterud 1975; Womac et al. 1993; 1994).

The recently carried out tests have proved that spray volume may amount to 200 l/ha, while spraying wheat with standard sprayers. It is assumed that wind speed during the practice will not exceed 3 m/s (Rogalski 1988; Gajtkowski and Czaczyk 1999).

In large farms farmers can not afford to wait for the weather changes and weakening or dying out of wind since the performing the treatment in accordance with the agricultural period would not be possible. These farms more and more frequently purchase and apply sprayers equipped with air sleeves which enable spraying even up to 8 m/s wind speed. It is known that the stronger wind blows, the higher air volume of the air sleeve flux must be. But the higher air volume may influence the quality of leaf coverage of the sprayed plant (Żuk 1996).

The carried out tests helped to describe the influence of air volume changes in the sprayer with the air sleeve on the quality of plant coverage by liquid while applying different spray volumes.

II. METHODS AND MATERIALS

The air assisted Air Plus Spridotrain sprayer equipped with the air sleeve, produced by RAU company was used for spraying; it had an air volume control ranging from 0–11. The air volume adjusted within range 0–54,000 m^3/h (air positions 1–11) was used during the tests. Three air volumes: air position 3 equalling 15,000 m^3/h; air position 5–24,000 m^3/h and air positions 7–35,000 m^3/h were used in the tests. Cone Jet TXVK-10 type nozzles were used and the pressure of the sprayed liquid was 0.5 MPa. Nozzle were placed at an angle of 30° enabling the airblast to force it to the heart of the crop. The spray volumes 202 l/ha, 269 l/ha and 403 l/ha were obtained at constant working width of 18 m and working speed of v_1=5 km/h, v_2=7.5 km/h and v_3=10 km/h. The liquid was pure water at the temperature of 15°C.

The measurement was accompanied by a steady sunny weather. The air temperature was 22°C, relative air humidity – 65% while wind speed oscillated between 1.5 and 2.5 m/s.

Water sensitive papers were used as spray collectors to measure spray coverage. The collectors were placed on leaves at three levels: I – top of a plant, II – half the height of the plant, III – ground surface. The papers were placed in three groups of 6 pieces at each level. The height of wheat reached 55 cm while their number was 420 plants per m^2.

The coverage was determined by using the Panasonic Color CCTV camera and the computer with the special program for the analysis of the images installed. Error did not exceed 2%.

III. RESULTS

The values of coverage of winter wheat leaf surface at top of plants, at half-height level and ground surface depending upon the air volume (positions 3, 5 and 7) and spray volumes (202, 269 and 403 l/ha) were presented in table 1. The table also presents means of the whole plant coverage as means from levels I and II. Means of coverage followed by the same letters do not differ significantly. Student's multiple range test t at the level significance of α = 0.05 was used for statistical evaluations.

Fig. 1 shows the dependence of the value of degree of winter wheat top coverage (level I) on liquid dosage per hectare (202, 269 and 403 l/ha) while applying three air volumes (positions: 3, 5 and 7). The successive values of coverage are described by help of the range of confidence interval. The highest quality of coverage was obtained at air volume position 5 (62% while using the volume of 202 l/ha). The increase of the volumes up to 269 l/ha effectively improved the quality of plant spraying and, first of all, at air volume position 5. At the highest spray volume (Q=403 l/ha), independently of the air volume, a very good spraying quality was achieved; the coverage reached 74–82%.

Fig. 2 presents dependences of the coverage s_k of the middle part of the plant (level II) on changeable parameters of the spray operation – air volume and spray volume. At the lowest dosage Q=202 l/ha spray quality was slightly worse; s_k oscillated from 16 to 44%, and the highest value was obtained at air volume position 5. Higher air volumes (position 5 and

Table 1

Coverage s_k of winter wheat at levels I, II and III; dependence on air volume (air pos. 3, 5 and 7) and spray volume Q

Coverage s_k (%)				
Air volume	Level I	Level II	Plant	Level III ground
Q = 202 l/ha				
Air pos. 3	22 (b)	16 (a,c)	19 (–)	6 (a,c,d,e,g,h)
Air pos. 5	62 (c,d)	44 (b–g,i)	53 (b–g)	2 (b,f,i)
Air pos. 7	57 (d,f)	28 (a,b,c,d,g)	43 (b,c,d)	7 (a–i)
Q = 269 (l/ha)				
Air pos. 3	56 (c,f)	44 (b–g,i)	50 (b–g)	3 (a–i)
Air pos. 5	84 (g)	58 (b,d–g,i)	71 (b,e–i)	2 (b–f,i)
Air pos. 7	60 (c,d)	64 (b,d–g,i)	62 (b,d–g,i)	2 (b–f)
Q = 403 (l/ha)				
Air pos. 3	81 (e,i)	52 (b–g,i)	67 (b,d–i)	7 (a,c,d,g,h,i)
Air pos. 5	82 (e,g,i)	86 (h,i)	84 (e,g,h,i)	7 (a,c,d,g,h,i)
Air pos. 7	74 (b,g)	70 (b,d–i)	72 (e–i)	3 (b-e,g,h,i)

* Means in the columns followed by the same letter do not differ significantly

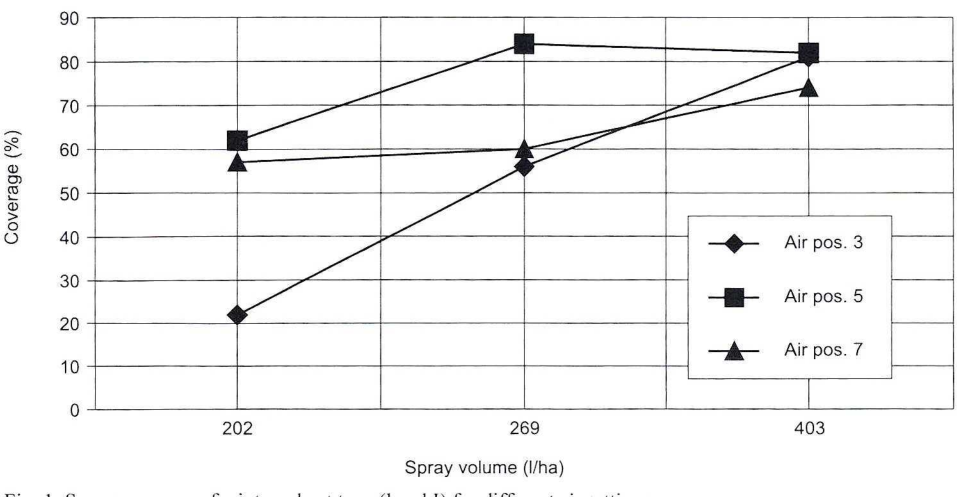

Fig. 1. Spray coverage of winter wheat tops (level I) for different air settings

7) brought about a meaningful improvement of spraying quality at higher volume of 269 l/ha. The highest diversification of quality was noticeable while applying the highest spray volume Q; the highest quality was reached at mean air volume (air position 5) when s_k went up to 86%.

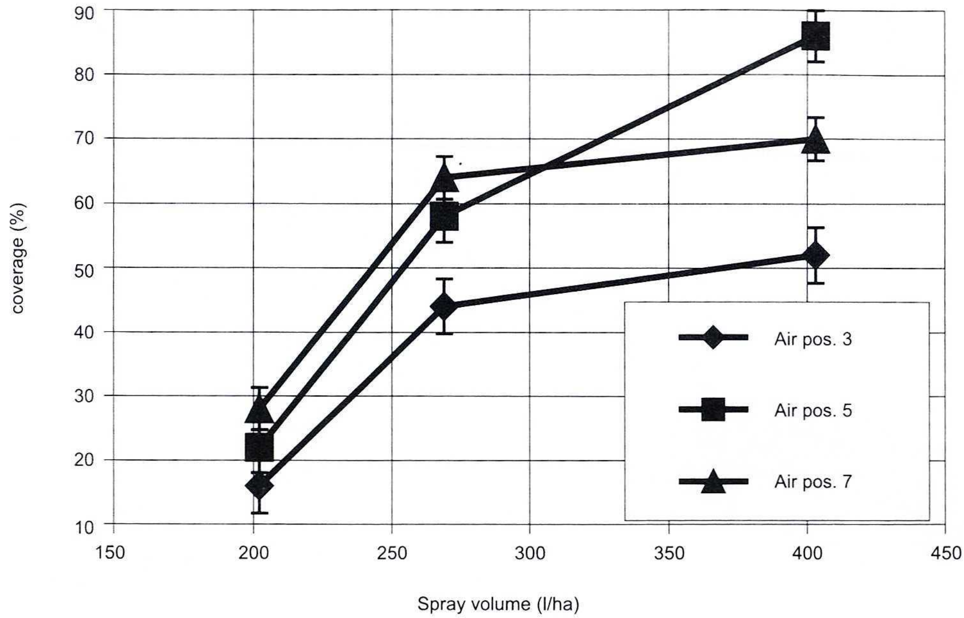

Fig. 2. Spray coverage of plant half the height (level II) for different air settings and spray volumes Q

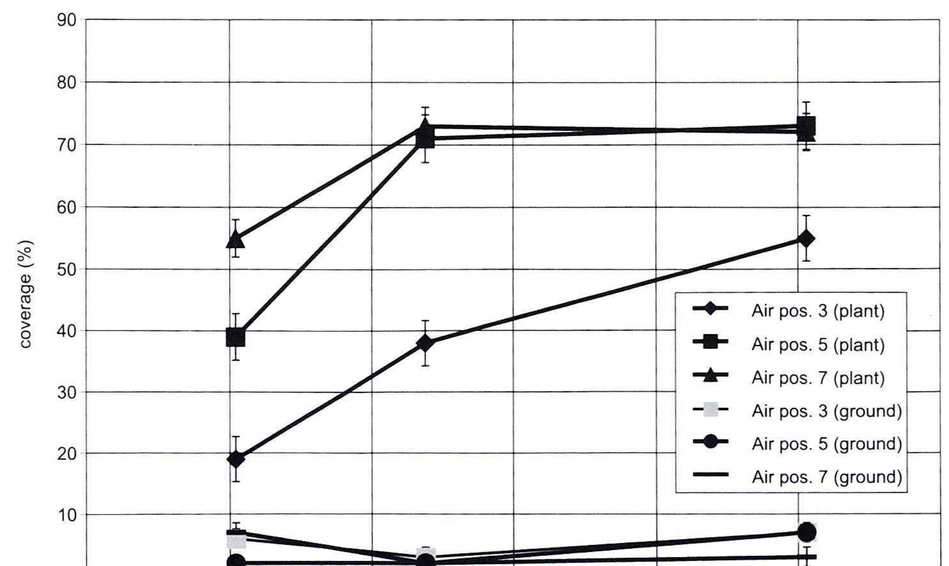

Fig. 3. Mean spray coverage of whole plant and spray coverage of the ground for different air sittings and spray volumes Q

Fig. 3 contains dependences of means of s_k index on air value and spray volumes for the whole plant, as well as at the ground level. The coverage over the whole plant was mean from levels I and II. Differences between air volumes were clearly observable while analysing coverage presented in this way (with the lowest spray volume). The lowest value was reached at the smallest air volume (air position 3), s_k=19% then; higher at highest volume (air position 7) – s_k=43%, and the highest at mean volume (air position 5) s_k=53%. The quality of plant coverage was visibly improved when spray volume was increased. The lowest coverage was obtained at the lowest air volume and the lowest spray volume (s_k=19%), and the highest at mean air volume and the highest spray volume (air position 5) – s_k reached 84%; it corresponds to all the range of the applied air volumes and spray volumes.

With the assumption that a sufficient spray was achieved with 15% coverage of leaves, plant coverage with the application of the sprayer in focus was good and for mean spray volumes could be defined as very good.

The dependence of soil surface coverage from the previously presented parameters, was presented in Fig. 3. Within the whole range of air volumes and spray volumes, the coverage oscillated between 2 and 7% and was either not significantly different or the differences were slight. It is important to notice that while applying the air sleeve sprayer in wheat, a relatively small ground was covered. The coverage was low independently of the spray volume, as well as setting of the air volume.

IV. CONCLUSIONS

The air volume from the sleeve influenced coverage of the wheat being sprayed both at the plant tops and in the middle of height.

Mean lowest coverage occured while applying the lowest spray volume (202 l/ha), higher while using mean volumes (269 l/ha) and the highest when the highest volume was delivered (403 l/ha); the highest the coverage, though was reached at the medium air volume.

Application of 403 l/ha and medium air volume from the air sleeve brought about a very high coverage – over 80%.

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VI. POLISH SUMMARY

WPŁYW DODATKOWEGO STRUMIENIA POWIETRZA NA JAKOŚĆ OPRYSKIWANIA PSZENICY

Opryskiwacze polowe wyposażane są w rękawy powietrzne w celu zmniejszenia znoszenia cieczy na sąsiednie pola. Zmiana wydatku dodatkowego strumienia powietrza z rękawa ma również wpływ na jakość opryskiwania roślin. Do badań zastosowano opryskiwacz AirPlus firmy RAU wyposażony w rozpylacze wirowe ConeJet TXVK-10. Opryskiwano pszenicę odmiany Roma.

Analiza wyników badań wskazuje na wpływ wydatku dodatkowego strumienia powietrza. Im wyższa dawka cieczy na hektar, tym lepsza jakość pokrycia liści pszenicy. Najwyższą wartość stopnia pokrycia powierzchni liści uzyskuje się przy dawce 403 l/ha i średnim ustawieniu wydatku powietrza (ponad 80%).