Results from Field Scale Trials Comparing Air Induction and Standard Flat Fan Nozzles at Reduced Volumes

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Summary

To evaluate biological efficacy using reduced volume spraying of fungicides comparing air induction drift reducing nozzles and standard flat fan nozzles, a series of field trials in winter wheat was carried out.

The field trials were quantitatively compared using the harvest yield, normalised to tonnes per hectare, for each treated plot.

Three field trials demonstrated that no significant effect could be found between all the treatments. The final trial (4) did not have the final planned fungicide treatment applied due to adverse weather conditions, therefore results may not be comparable with the other field trials, however this trial demonstrated that a lower volume application may, in these limited circumstances, adversely affect yield. However the selection of nozzle type (air inducing and conventional flat fan) did not affect yield (as a single factor) in any of the field trials.

Introduction

To ascertain levels of biological efficacy whilst increasing work rates, trials have been carried out with reduced volume applications to compare air induction with standard flat fan nozzles in four field trials for fungicides in winter wheat. The results of these trials are discussed in this paper.

Materials and Methods

Four field trials were set up in winter wheat in the spring of 2003. The winter wheat was divided into large plots, and the routine fungicide treatments were carried out using either air inducing or flat fan nozzles and at two water volumes (50 and 100 $l.ha^{-1}$).

The application of pesticides was made using the normal farm or contractor's machinery.

The collection of data, was made at harvest by assessing the yield, this was done by using the farmers combine harvester grain monitor. Correction factors were applied to the data to ensure comparability.

Trial 1 - Crop Winter Wheat "Savanna"
The farm sprayer, a 24m Bateman self-propelled sprayer was used in a block of 4.0 ha in a field of the above crop. The 4.0 ha block was divided into 16 x 0.25 ha plots to give a total area of 1.0 ha for each of the four treatments. Each plot was 104 m x 24 m. No two plots of similar treatment were adjacent one to another.

The four treatments were two each at 100 $l.ha^{-1}$ and two at 50 $l.ha^{-1}$ using Flat fan nozzles 01F110 Orange and Billericay Air Bubble Jets ABJ01 Orange for 50 $l.ha^{-1}$ and 02F110 Yellow plus Billericay Air Bubble Jet ABJ02 Orange for 100 $l.ha^{-1}$. The operating speed was constant at 10 $km.h^{-1}$. Fungicides used

- 23rd April 2003. Azoxystrobin (Amistar) + Epoxiconazole (Opus)
- 24th May 2003. Azoxystrobin (Amistar) + Epoxiconazole (Opus)
- 7th June 2003. Tebuconazole (Folicur)

NOZZLE TYPE	APPLICATION RATE	YIELD (Tonnes/ha)
Standard flat fan 02	100 l.ha^{-1}	9.2
BFS Bubblejet 02	100 l.ha^{-1}	9.1
Standard flat fan 01	50 l.ha^{-1}	9.1
BFS Bubblejet 01	50 l.ha^{-1}	9.0

Table 1. Summarised grain yields from trial 1.

Table 1 demonstrates that there was no significant differences found when using the summarised data, between either nozzle type or volume rate, when considering yield alone. Further discussion of the data on a plot by plot basis will take place later in this paper.

Trial 2 - Crop Winter Wheat (second) "Savanna"

The farm sprayer, a. trailed Hardi with 24m boom was used. The plot was 24m wide and 420 m long giving an area of 1 ha for each plot.

Two different sizes of standard flat fan nozzles were used to apply fungicides to the above crop at 50 l.ha^{-1} and 100 l.ha^{-1}. The nozzles used were FF110 015 for 50 l.ha^{-1} and FF110 025 for 100 l.ha^{-1}. The speed was constant at12 km.h^{-1}

Fungicides used

- Zadoks GS 39-45 Azoxystrobin (Amistar) + Epoxiconazole (Opus)
- Zadoks GS 59-65 Azoxystrobin (Amistar) + Metconazole (Caramba)

NOZZLE TYPE	APPLICATION RATE	YIELD (Tonnes/ha)
Standard flat fan FF110 025	100 l.ha^{-1}	7.41
Standard flat fan FF110 015	50 l.ha^{-1}	7.38

Table 2. Summarised grain yields from trial 2.

Trial 2 was used to assess the influence of water volume in routine fungicide treatments using flat fan nozzles, no significant differences were found when considering yield alone.

Trial 3 - Crop Winter Wheat (fourth) "Option"

The farm sprayer, a Knight Farm Machinery tractor mounted with 24 m boom was used. The plots were 24 m wide and 90m long giving an area of 0.216 ha for each plot.

Two different sizes of Air Induction nozzle were used to apply fungicides to the above crop at 50l.ha^{-1} and 100 l.ha^{-1}. The nozzles used were BFS Air Bubblejet ABJ015 Green for 50 l.ha^{-1} and Amistar nozzle (Syngenta) for 100 l.ha^{-1}. The speed was constant at 12 km.h^{-1}

Fungicides used

- 27th April 2003. Zadoks GS 32. Azoxystrobin (Amistar) + Epoxiconazole (Opus)
- 23 May 2003. Zadoks GS 39-45. Azoxystrobin (Amistar) + Epoxiconazole (Opus)

NOZZLE TYPE	APPLICATION RATE	YIELD (Tonnes/ha)
BFS Bubblejet 015	50l.ha^{-1}	9.6
Amistar nozzle 025	100 l.ha^{-1}	9.6

Table 3. Summarised grain yields from trial 3.

Trial 3 compared two different air inducing nozzles at two water volumes, no significant differences were found when considering yield alone.

Trial 4 - Crop Winter Wheat "Charger"

The farm sprayer a trailed Knight Farm Machinery with 20m boom was used. The plots were 40 m wide and were 250m long giving an area of 1.0 ha for each plot. Three different nozzles were used to apply fungicide to the above crop at 50 l.ha^{-1} and 100 l.ha^{-1}. Two different air induction nozzles and a standard

flat fan. The nozzles used were. 50 l.ha^{-1} Billericay Bubblejet ABJ015 green 100 l.ha^{-1} Amistar nozzle (Syngenta). Flat Fan 025 F110. The operating speed was constant at 12.5 km h^{-1}.
Fungicides used

- 23rd April 2003. Zadoks GS 32. Chlorothalonil (Bravo) + Epoxiconazole (Opus)
- 21st June 2003. Zadoks GS 47-51. Azoxystrobin (Amistar) + Epoxiconazole (Opus). (Treatment A), or
- 21st June 2003. Zadoks GS 47-51. Trifloxystrobin (Twist) = Epoxiconazole (opus). (Treatment B).
- Application on 21st June was delayed due to adverse weather.
- Final spray (Zadoks GS 59-65) was not applied due to adverse weather.

NOZZLE TYPE	***APPLICATION RATE***	**YIELD (Tonnes/ha)**
Standard flat fan A	100 l.ha^{-1}	9.0
Standard flat fan B	100 l.ha^{-1}	9.1
BFS Bubblejet A	50 L.ha^{-1}	8.2
BFS Bubblejet B	50 l.h^{-1}	8.3
Amistar nozzle A	100 l.ha^{-1}	9.0
Amistar nozzle B	100 l.ha^{-1}	9.0

Table 4. Summarised grain yields from trial 4. The second fungicide treatment (A or B) is stated by each plot.

Trial 4 did not have the final application of the fungicide programme applied, due to adverse weather conditions. The second treatment was applied late, and two fungicide mixtures were used. Harvest yield for these two fungicide mixtures did not show any significant differences. The data must therefore be treated with due caution however it is possible to state that the reduced volume application did have an adverse effect on harvest yield in these limited circumstances.

Results and Discussion

The trials detailed above were all carried out in the growing season 2002-2003 on a number of farms across the United Kingdom. The use of reduced volumes for fungicide applications with the objective of increasing work rates and improving timeliness of application is becoming an accepted technique in the UK (Butler-Ellis *et al*, 2004*)*. The use of air induction nozzles to reduce drift is also common practice and studies have been done to compare different Air Induction nozzles with different droplet size characteristics (Powell, *et al.* 2002*)* These trials compare two different air induction nozzles with relatively "Small" droplets (Butler-Ellis *et al.* 2001*)* and standard flat fans.

The trials were assessed on harvest yields and were not full factorial experiments.

Trial 1 was divided into 16 plots, (4 treatments), the summarised data showed no significant differences, however a more detailed assessment (Table 5) demonstrated that certain treatments had a higher variation within the plots then the standard flat fan application at 100 l.ha^{-1}.

Treatment	**Plot yield normalised to tonnes.ha^{-1}**				**Average yield tonnes.ha^{-11}**
FF110-02 100 l.ha^{-1}	9.372	9.027	9.027	9.237	9.166
BFS Bubblejet 02 100 l.ha^{-1}	9.347	9.130	8.736	8.883	9.022
FF 110-01 50 l.ha^{-1}	8.880	9.443	9.614	8.536	9.114
BFS Bubblejet 01 50 l.ha^{-1}	8.882	9.383	9.112	8.970	9.087

Table 5. A table to show individual plot yields from trial 1. CV = 3.157% Standard deviation = 0.287.

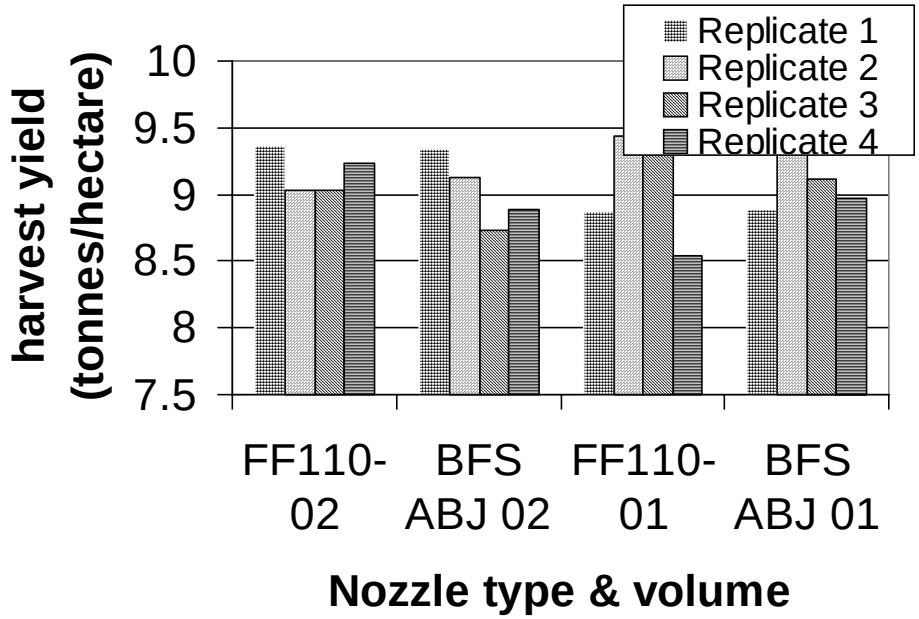

Figure 1. A graphical representation of variation between plot yields in trial 1.

Figure 1 is a pictorial representation of the plot yields. While field data is known to be variable, the data from the lower volumes appears (within the confines of this this experiment) to show greater variability than that of the 100 $l.ha^{-1}$**.** Further work would be needed to validate this finding.

Trials 2 and 3, compared volume rates of air inducing and flat fan nozzles, no significant differences in yield were found and this may indicate that lower volumes may be used without affecting harvest yields. Further work would need to be carried out to validate this work.

Trial 4, due to adverse weather conditions missed one fungicide treatment and had a late second application. This may have affected the harvest yields, however the main difference was that of the 50 $l.ha^{-1}$ treatment which had a lower yield than the other 100 $l.ha^{-1}$ treatments.

Conclusions

The findings of this experiment are preliminary, and further works will be necessary in this field. The experiment found that if fungicide treatments are applied on time then lower water volumes may be used, however if treatments are applied after the optimum timings then this may adversely affect harvest yield.

The use of air inducing nozzles (with “small” droplets) did not adversely affect harvest yield, when compared to conventional flat fan applications. While this conclusion is preliminary and further works are required, this should have the effect of increasing potential spray days and reducing environmental contamination and increasing work rates.

Acknowledgements

The author would like to thank; Tom Robinson, Syngenta Crop Protection. Professor P C H Miller, Silsoe Research Institute. Brian Taylor “Taylands” Independent Research. Stephen Kateley, Billericay Farm Services Ltd. For their help and encouragement in preparing this paper.

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