INTERACTION BETWEEN SOME FUNGICIDES AND APPlicator-TYPES OF SPRAYER IN CONTROLLING POWDERY MILDEW DISEASE OF WHEAT.

El-Shamy, M.M.* and H.A. El-Gendy**


ABSTRACT

The objective of this work was to study the interaction between three systemic fungicides belonging to triazole group and three mechanical applicator types of sprayer, i.e. high volume (HV), low volume (LV) and ultra low volume (ULV) in controlling wheat powdery mildew. This study was carried out at Gommeizza Research Station during two growing seasons (2004-2005).

The fungicides aminit (Teioconazole) and sumi-B(Diniconazole) gave the highest values of efficacy in controlling the disease with either of L.V. or H.V. (93.75 & 92.25 % and 87.75 & 93.75 %) and (89.58 & 93.75 % and 85.42 & 93.75 %) sprayers in 2004-2005, respectively. While, the fungicide till (Propiconazole) showed the lowest values in this respect with all sprayer types. Good and significant interactions were found between the fungicides and the type of sprayer. The sprayer's L.V. and H.V. gave the lowest mean of disease severity (10.95, 6.54 % and 13.33, 10.00 % respectively in the years 2004-2005. While ULV sprayer showed the highest mean of disease severity (53.33 and 51.98 %).

Technical laboratory tests indicated that the ULV applicator produced very small droplets (196 droplets per cm² of 92 µm in diameter), The LV applicator produced small spray droplets (144 droplets per cm² of 174 µm in diameter), while the HV applicator produced relatively large spray droplets (69 droplets per cm² of 213 µm in diameter). Spray using HV applicator depend on the pressure of the handle pump. Also, the LV applicator works using air pressure with air velocity about 43.7 m/sec. The two sprayers produced large droplets compared with the ULV sprayer. Droplets of HV and LV interfere the heavy growth plants with drag force by pressure and air velocity respectively. Meanwhile, spray using ULV applicator which works with centrifugal force produced very small fine droplets that have low speed. Therefore, it's ability to interfere the heavy growth plants will not occur.

These results put spotlight on the importance of choice the type of sprayer to the kind of the crop plant. The plants that heavy growth i.e. wheat (300-350 tiller/m²) must be sprayed with sprayer has drag force of droplets while the crops that vast leaves i.e. cucurbitaceae must be sprayed with ULV sprayer for controlling plant diseases.

INTRODUCTION

Powdery mildew caused by Erysiphe graminis is one of the commonest and most widespread wheat diseases. Because of its very widespread distribution, frequent occurrence and ability to attack all wheat cultivars, powdery mildew can cause extensive damage. Early infection results in leaf loss and impairment of shoot and root development, this becomes evident during the harvest by the reduced number of ear bearing tillers. The most frequent form of damage following early attack, if attack occurs during the
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Main growth stage, starch storage in the grains is reduced leading to losses of breeding quality or shriveled grain information. Chemical control to powdery mildew disease has been considered the main goal to increase the wheat production especially with the absence of resistant varieties.

Inefficiencies of the chemical application process are inherent to the complex structure of the target crop, the location of the target disease within the crop canopy, and the method and equipment used for spray application. Spray penetration and deposition characteristics and control efficacy are among the most often considered factors in applying the research. The inefficiency and accuracy of the agricultural chemical application can be alleviated by understanding the fundamental concepts of transport, penetration and deposition of the spray in correlation with the plant canopy structures (Giles, 1989). Farm equipments for applying fungicides and pesticides plays an important role in controlling plant diseases. Several types of spraying devices had been used in agricultural applications (Awady and Afifi, 1976; Ismail and Eder, 2004 and El-Meserey and Abd El-Fattah, 2005).

To improve the efficiency of spraying, and decrease the injury percent and the quantity of liquid, different fungicides were used. Awady (1977), and Azime et al., (1985) showed that the atomizer has three atomization functions, to regulate the flow-rate to form and control droplet size and to disperse and distribute the droplets in a specific pattern. Keppner et al., (1982) mentioned that the degree of atomization depends upon the characteristics and operating conditions of the atomizing device and upon the characteristics of liquid being atomized. Moustafa and Ismail (2003) studied the effect of the different fungicide applicator types on the efficacy of fungicides used to control late blight disease caused by Phytophthora infestans on potato. They found that, using the ULV applicator resulted in reduction of the fungicide amount needed to perform appropriate control of this disease from 400 l/ha, (the recommended amount) to 50 l/ha. The lowered amount of the fungicide run-off in turn saves the environment and decreases the crop production costs.

This work was carried out to study the interaction between some fungicides and technical applicators (sprayers) in controlling wheat powdery mildew.

MATERIAL AND METHODS

The experimental layout:

This study was carried out at Gemmelza Research Station in 2003/2004 and 2004/2005 growing seasons. Split-plot design was followed in this experiment. The main plots were the type of sprayer, while the tested fungicides comprised the sub-treatments. The highly susceptible wheat variety, Sakha 61 was grown in 36 plots (3 x 1.2 m). Grains were drilled in rows spaced 20 cm apart, and the plot contained 6 rows. The experimental plots were surrounded by a border from the susceptible variety little club with one meter.
Inoculation technique:
For inoculation, the powdery mildew culture was raised on little club seedlings grown in 10 cm pots under greenhouse conditions from infected plants collected from the trap nursery. Two pots of 10 days old culture were potted in the middle of the border every 2 meter. Later after one week, the infected pots were rubbed over the border plants.

The tested fungicides:

Three systemic fungicides belonged to triazole group were used in this study namely: Diniconazole, Propiconazole and Tetraconazole (Table 1). These fungicides were sprayed twice; once the powdery mildew appear and after 15 days of the first spray. The control treatments were sprayed by water. Efficacy of the fungicides was determined according the equation adopted by Rewal and Jhouty (1985) as follow:

\[
\text{Efficacy} \% = \frac{\text{Infection in control} - \text{Infection in treatment}}{\text{Infection in control}} \times 100
\]

<table>
<thead>
<tr>
<th>Trade name/concentration/formulation</th>
<th>Common name</th>
<th>Chemical name</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sumil-8 5% EC</td>
<td>Diniconazole</td>
<td>(E)-(RS)-1 (2,4-dichlorophenyl) 4,4di-methyl-2-(1H-1,2,4-triazol-1-yl)pent-1-en-3-ol (IUPAC)</td>
<td>35 ml/100 L.</td>
</tr>
<tr>
<td>Tilt 10% EC</td>
<td>Propiconazole</td>
<td>1-(2,4-dichlorophenyl)-4-propyl 1,3-dioxolan-2-y1 methyl-1H-1,2,4-triazol-1-y1</td>
<td>100 ml/100 L.</td>
</tr>
<tr>
<td>Eminent 12.5% EW</td>
<td>Tetraconazole</td>
<td>4)-2-(2,4dichlorophenyl)-3-(1,2,4-triazol-1-y1 propyl 1,2,2-trifluoroethyl ether (IUPAC)</td>
<td>100 ml/100 L.</td>
</tr>
</tbody>
</table>

DISEASE ASSESSMENT:
Infection severity was estimated visually as a percentage of leaf area covered with colonies, according to the scale 0-6 (Baiou, 1986) which: 0 = no visible colonies on leaves; 1 = 1-9 % of leaf area covered with colonies; 2 = 10-19 % of leaf area covered with colonies; 3 = 20-35 % of leaf area covered with colonies; 4 = 35-50 % of leaf area covered with colonies; 5 = 51-75 % of leaf area covered with colonies; 6 = more than 75 % of leaf area covered with colonies. Twenty plants were selected randomly at each plot to estimate disease severity on the whole plants.

Yield components:
Grain yield and 1000 kernel weight of each treatment as well as the control treatment were determined and the increase percentage was calculated by the formula adopted by:

Increase % = \( \frac{\text{Treatment} - \text{control}}{\text{control}} \times 100 \)
Engineering consideration:
The engineering specification referring to the types of sprayers under experiment were:

1- The sprayer No 1 (Knapsack sprayer)
   This sprayer has high volume of droplet (HV) and has metal hand larse tube with one nozzle (hollow cone type).
   The stream of liquid flowing out of the swirl chamber (Fig. 1-a, 1-b) is may subjected to the action of the following internal forces:
   1-Surface tension which opposes the breaking of the stream and tends to shape the smallest possible surface.
   2-Viscosity which opposes deformations of the stream.
   3-Cohesion opposing the breaking up the stream as a result of a difference in velocity of the individual points.
   As shown in (Fig. 1) the hollow cone type have a swirl chamber, which it can be positioned immediately after the inlet orifice to reduce the proportion of small droplets produced by one nozzle and thus reduce drift.
   The liquid is conveyed to the swirl chamber (Fig. 1-b) with radius "R", through the opening with a radius "r_0". Under the effect of the pressure produced by the pump action, the liquid in the chamber begins moving in the direction of the axis and is also set into a revolving motion produced by the initial angular momentum.

![Diagram](image)

(a)

(b)

Fig. (1): High volume sprayer, the liquid's outflow from the swirl nozzle.

At every particular point of the chamber a situation may be expressed by using the Bernoulli's equation as follow:

\[ \frac{P}{Q} + \frac{V^2}{2g} + \frac{u^2}{2g} = H \]

Where:
- \( H \) = the total pressure supplied by pumping action, Pascal
- \( P \) = the static pressure at a particular point, Pascal
- \( Q \) = the amount of liquid discharge, L/sec
- \( V \) = the tangential velocity of the liquid element, m/sec
- \( u \) = the axial velocity of the liquid, m/sec
- \( g \) = the acceleration due to the earth gravity, m/sec^2

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2- The sprayer machine No 2 (LV) (Air carrier sprayer)

The engineering consideration of the air carrier sprayer nozzle as shown in Fig. (2) are:

1. The sprayer have rotating radial tube.
2. The liquid breaking in a stream air.

The blower of the sprayer are actuated by an internal combustion engine of about 2 HP and mounted on a frame carried on the operator's shoulders. The engine drives the impeller and the liquid flows down by gravity to the nozzle situated at the outlet orifice of the air tube (Fig. 2-a)

Fig. (2-a): The air carrier sprayer.

1. Engine
2. Fuel tank
3. Fan
4. Nozzle
5. Liquid tank
6. Valve
7. Liquid conduits
8. Air tube

By zooming the shape of nozzle in Fig. (2-a), the Fig. (2-b) is obtained. The nozzle of the air carrier sprayer (Fig. 2-b) meet each of liquid sprayer and the ejected air. A droplet of liquid is subjected to external forces resulting from resistance of the medium as well as the internal forces arising from the surface tension.

Fig. (2-b): The nozzle fan carrier sprayer.

1. Casing
2. Venture tube
3. Injector tubes
4. Connector pipe
5. Liquid flow direction
6. Air flow direction
In general, the process of droplet breaking can be presented if:

\[ P_1 = P_a + P_s \]

Where:
- \( P_1 \) = the internal pressure of a constant volume.
- \( P_a \) = the external pressure.
- \( P_s \) = the pressure produced by surface tension for a sphere

On the other hand, the \( P_s \) is equal to

\[ P_s = \frac{2\sigma}{r} \]

Where:
- \( \sigma \) = surface tension, \( \text{N/cm}^2 \)
- \( r \) = the radius of the droplet, \( \text{cm} \)

3- The sprayer No 3 Ultra-low volume (ULV)

Referring to the position of spinning disc "ULV" during operation in field, the inclination angle of the spray shape distribution may take the form as shown in Fig. (3).

![Diagram](image)

Fig. (3): The imitation of the spinning disc during operation in the field.

The volume of spray applied is restricted to prevent the flooding of the nozzle. A suitable formulation and flow rate are selected to that at a given rotational speed droplet formulation form ligaments with minimal number of satellite droplets.

The sprayer distribution form but only depends on the selected size but also on the engineering parameter of spinning-disc sprayer. The angle of spinning-disc the number of disc rotation, and the disc set level are the most important parameters controlling the width of spray out.

The velocity \( v \) of the droplet going out from the rotating disc of sprayer is the resultant of the tangential velocity of disc end \( V_T \) and of the radial velocity \( V_r \) at the moment of leaving the disc.

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Let us assume a mass of droplet \( m \) and the atomizer (rotary disc) revolves around its axis (Fig. 3) at constant angular velocity \( \omega \). The only force which affects the droplet’s motion is the centrifugal force \( m \omega^2 x \), where \( x \) is the droplet’s momentary distance from the axis of rotation. The mass of the droplet can, as negligibly small, be disregarded in the calculation.

As referring to the Fig. (3); let assume the distance between the splat of distribution of spray and the atomizer disc as \( r_1 \) and the distance from the end as \( r_2 \). The relative radial velocity of the droplet at the point “A” is denoted by \( V_{ba} \) and at “B” by \( V_{b} \). On the displacement \( dx \), the force \( ma \) performs the work.

\[
\frac{dL}{dx} = m \omega^2 x \quad (1)
\]

\[
dL = m \omega^2 x \, dx
\]

\[
\int^b_a dL = m \omega^2 \int^x_r x \, dx
\]

\[
[m \, V_{b}^2 - m \, V_{ba}^2] = \frac{1}{2} m \omega^2 (x^2 - R^2) \quad (4)
\]

Hence, on integration and reduction

\[
[V_{b}^2 - V_{ba}^2] = \frac{1}{2} \omega^2 (x^2 - R^2) \quad (5)
\]

\[
\therefore V_{b} = \sqrt{V_{ba}^2 + \frac{1}{2} \omega^2 (x^2 - R^2)} \quad (6)
\]

But \( V_b = \frac{dx}{dt} \), therefore after separation of the variables

\[
dt = \frac{dx}{V_b}
\]

\[
dt = \frac{dx}{\sqrt{\frac{V_{ba}^2}{\omega^2} + \frac{1}{2} (x^2 - r^2)}}
\]

\[
dt = \left[ \frac{2 \, V_{ba}^2}{\omega^2 + x^2 - r^2} \right]^{\frac{1}{2}} \, dx
\]

On integration and assuming that for condition \( x = r \) and \( t = 0 \) we obtain:
\[
\int dt = \int \left[ \frac{2V_a^2}{\omega^2} + \frac{V_a^2}{\omega^2} - r^2 \right]^{\frac{1}{2}} dx
\] (10)

\[
\omega t = \left[ x + \sqrt{\frac{2V_a^2}{\omega^2} + x^2 - r^2} \right] \left[ r^2 + \frac{V_a}{\omega} \right]
\] (11)

Using the above equation, we can calculate the relative radial velocity \(V_a\), if we know the disc of sprayer radius \(r\) it's easy to determine the distance of the droplet from the rotation axis to the end of the spray distribution surface.

According to the engineering consideration for the three of the sprayer machine under experiment, it found that the main parameters affecting the operation of knapsack sprayer (No 1) are the amount of liquid discharge, the velocity of liquids introduced into the nozzle chamber and the nozzle opening radius. While, the parameters affecting air carrier sprayer are the surface tension and the pressure.

But for the spinning disc the parameter affecting spray distribution is the centrifugal speed of sprayer disc (Eq. 12)

**Droplets size analyses and coverage efficiency:**

Foliage coverage efficiency of each applicator was determined by measuring the spray deposits, (number of droplet per square centimeter and the volume median diameter).

The plants were divided into three levels: top; middle; and bottom to represent the higher, middle and lower leaves respectively, in the fashion used by Awady and Afifi (1976). Water sensitive paper cards were fixed on plants at straight radial lines on each level. The plants were treated with the different fungicides using the different applicator types. After the plant got dry, the cards were collected, the spray droplets were counted per square centimeter (No/cm²). The volume median diameter (VMD) of each sprayer was calculated according to the following formula (Awady, 1977):

\[ VMD = \left[ \sum_{i=1}^{n} n_i \times X_i^3 / \sum_{i=1}^{n} n_i \right]^{\frac{1}{3}} \]

Where:-

\( n = \) Summation of number of droplets at each classification of droplet size class.

\( X = \) Droplet diameter for given class.

**Statistical analysis procedure:**

All the data were subjected to statistical analysis according to the procedures (ANOVA) adopted by Snedecor (1957). Means of treatments were compared by the Least Significant Differences test "L.S.D" at 5 % level of probability.
RESULTS AND DISCUSSION

Data in Tables (2 & 3) reveal a significant differences were found between either the fungicides or the types of sprayers concerning with disease severity, grain yield/m² and 1000 kernel weight (KW). Good interaction is present between the tested fungicides and sprayer types.

Table 2: Interaction between three fungicides and three types of sprayers in controlling powdery mildew of wheat during 2003/2004 growing season at Gemmelza Station.

<table>
<thead>
<tr>
<th>Sprayer type</th>
<th>Fungicide</th>
<th>Reaction Disease severity%</th>
<th>Efficacy %</th>
<th>Grain yield / m²</th>
<th>Increase %</th>
<th>1000 KW gm.</th>
<th>Increase %</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.V.</td>
<td>Sumi-8</td>
<td>11.66</td>
<td>85.42</td>
<td>0.813</td>
<td>53.10</td>
<td>43.26</td>
<td>36.16</td>
</tr>
<tr>
<td></td>
<td>Tilt</td>
<td>20.00</td>
<td>75.00</td>
<td>0.759</td>
<td>42.93</td>
<td>42.28</td>
<td>33.08</td>
</tr>
<tr>
<td></td>
<td>Eminent</td>
<td>8.33</td>
<td>88.58</td>
<td>0.824</td>
<td>55.17</td>
<td>43.68</td>
<td>37.48</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>13.33</td>
<td></td>
<td>0.798</td>
<td></td>
<td>43.07</td>
<td></td>
</tr>
<tr>
<td>L.V.</td>
<td>Sumi-8</td>
<td>10.00</td>
<td>87.75</td>
<td>0.643</td>
<td>58.75</td>
<td>43.76</td>
<td>37.74</td>
</tr>
<tr>
<td></td>
<td>Tilt</td>
<td>16.66</td>
<td>79.17</td>
<td>0.778</td>
<td>45.61</td>
<td>42.92</td>
<td>35.09</td>
</tr>
<tr>
<td></td>
<td>Eminent</td>
<td>5.00</td>
<td>93.75</td>
<td>0.853</td>
<td>60.34</td>
<td>43.81</td>
<td>37.89</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>10.55</td>
<td></td>
<td>0.824</td>
<td></td>
<td>43.49</td>
<td></td>
</tr>
<tr>
<td>U.L.V.</td>
<td>Sumi-8</td>
<td>50.00</td>
<td>37.50</td>
<td>0.595</td>
<td>12.05</td>
<td>37.85</td>
<td>19.13</td>
</tr>
<tr>
<td></td>
<td>Tilt</td>
<td>60.00</td>
<td>25.00</td>
<td>0.662</td>
<td>5.83</td>
<td>35.79</td>
<td>12.65</td>
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<tr>
<td></td>
<td>Eminent</td>
<td>50.00</td>
<td>37.50</td>
<td>0.588</td>
<td>10.73</td>
<td>37.29</td>
<td>17.37</td>
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<tr>
<td>Mean</td>
<td></td>
<td>53.33</td>
<td></td>
<td>0.581</td>
<td></td>
<td>36.97</td>
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</tr>
<tr>
<td>Control</td>
<td></td>
<td>80.00</td>
<td></td>
<td>0.531</td>
<td></td>
<td>31.77</td>
<td></td>
</tr>
</tbody>
</table>

The fungicide eminent (Tetraconazole) sprayed by either U.L.V or H.V sprayers gave the lowest powdery mildew diseases severity (5.00, 3.33 %) in 2004 season and (3.00, 5.00 %) in 2005 season. Sumi-8 fungicide (Dimiconazole) came in the second rank releasing (10.00, 11.66 %) in year 2004 and (5.00, 5.00 %) in the second year 2005. While the fungicide tint (Propiconazole) showed the lowest efficacy in controlling powdery mildew with all the used sprayers. It could be noticed that disease severity increased with all the fungicides by using U.L.V sprayer, which ranged from 50-60%, consequently their efficacy were lower (25.00-37.50 %).

In another study, Hussein, Mamdouha (1998), she stated that the best effective fungicides as foliar sprays to control barley powdery mildew were Cyproconazole and Triadimefon. Also, El-Salimomy (2002) found that sumi-8 (Dimiconazole) was the best for controlling wheat powdery mildew under greenhouse condition. Lipps and Madden (1969) reported that spray timing of fungicides is mostly important especially when applied at the early stage of disease development but, one spray hasn't got a good effect and ensure protection during the adult stages.
Table 3: Interaction between three fungicides and three types of sprayers in controlling powdery mildew of wheat during 2004/2005 growing season at Gemmalza Station.

<table>
<thead>
<tr>
<th>Sprayer type</th>
<th>Fungicide</th>
<th>Reaction Disease severity</th>
<th>Efficacy %</th>
<th>Grain yield / m²</th>
<th>Increase %</th>
<th>1000 kg</th>
<th>Increase %</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.V.</td>
<td>Sumi-8</td>
<td>5.00</td>
<td>93.75</td>
<td>0.822</td>
<td>55.38</td>
<td>43.24</td>
<td>36.23</td>
</tr>
<tr>
<td></td>
<td>Tilt</td>
<td>20.00</td>
<td>75.00</td>
<td>0.799</td>
<td>51.03</td>
<td>42.17</td>
<td>23.86</td>
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<td>93.75</td>
<td>0.832</td>
<td>57.27</td>
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<td>Mean</td>
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<td>L.V.</td>
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<td>0.825</td>
<td>55.95</td>
<td>43.59</td>
<td>37.33</td>
</tr>
<tr>
<td></td>
<td>Tilt</td>
<td>11.66</td>
<td>85.42</td>
<td>0.800</td>
<td>51.22</td>
<td>42.03</td>
<td>32.41</td>
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<td></td>
<td>Eminent</td>
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<td>96.26</td>
<td>0.842</td>
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</tr>
<tr>
<td>Mean</td>
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<td>0.822</td>
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<tr>
<td>U.L.V.</td>
<td>Sumi-8</td>
<td>50.00</td>
<td>37.50</td>
<td>0.610</td>
<td>15.13</td>
<td>37.69</td>
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<td></td>
<td>Tilt</td>
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<td>35.73</td>
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<td>Eminent</td>
<td>45.00</td>
<td>77.08</td>
<td>0.618</td>
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<td>0.604</td>
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<tr>
<td>Control</td>
<td></td>
<td>80.00</td>
<td></td>
<td>0.529</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

L.S.D. at 0.05: A 1.51, B 0.81, A X B 1.41

Significant interaction was found between the used sprayers in increasing the efficacy of the fungicides. The LV sprayer showed the lowest mean disease severity of powdery mildew (10.55% and 6.54%) followed by HV sprayer (13.33% and 10.00%) in the years 2004-2005, respectively. While the use of ULV sprayer gave the highest mean of disease severity (53.33 and 51.66%) in these two years, consequently reduced the efficacy of the tested fungicides. These results indicate that using LV sprayer was more effective in controlling wheat powdery mildew of wheat followed by HV sprayer comparing with ULV sprayer. These results may be attributed to the ability of L.V and HV sprayers to move the leaves of wheat by its air power and arrive the fungicide to all parts of the plants consequently to the colonies of powdery mildew. This will be reflected on the increase of fungicide efficacy in controlling the disease. El-Mesayry and Abd-EL-Fattah (2005) reported that the knapsack sprayer (H.V.) was better than Mistblower sprayer (LV) for weed control in wheat crop. They attributed their results to the special properties of each sprayer. In contrast of these results, Ismail and Bader (2004) obtained different levels of efficacy when using three types of applicators i.e., ULV, LV and HV sprayers to control cucumber downy mildew by Ridomil plus. ULV applicator showed the highest disease control efficacy, followed by LV applicator, while H.V applicator was the least in this respect. It could be attributed to the size of cucumber leaves and the small number of plants in the area unit.

The interaction between fungicides and sprayer types was reflected on the increase grain yield/m² and 1000 kernel weight. Spraying the fungicide Eminent by LV gave the highest mean increase % of grain yield (0.824%...
0.922 kg/m²) and 1000 kernel weight (43.49 & 43.15 g) in the years 2004
and 2005, respectively. HV sprayer with the three fungicides came in
the second rank releasing (0.798 & 0.817 kg/m²) for grain yield and (43.07 &
42.89 gm) for 1000 kernel weight in the two seasons, respectively. ULV
sprayer gave the lowest values of the two parameters with all the fungicides
(0.581 & 0.504 Kg/m²) and (36.97 & 37.13 gm) for grain yield/m² and 1000
kernel weigh, respectively. It could be mentioned that approximately 2
percent of yield will be lost for every 1 percent of flag-leaf area infected by
powdary mildew above 5 percent level (Small Grain Variety Report and in
2000 Alabama Pest Management Handbook) Chapter "Small Grain Insect,
Disease and Weed Control Recommendation".

Droplet size analyses of each applicator:

The data presented in (Table 4) indicated that the ULV applicator
gave the highest number of droplets either on the upper, middle or on the
lower leaves. It was manifested, that in all cases, the highest number of
droplets was found on the upper leaves, this number decreased gradually on
the middle and lower leaves; however this decreasing of the number of
droplets differed from an applicator to another.

Table 4: Distributions of the spray suspension droplets per cm² and
volume mean diameter (VMD).

<table>
<thead>
<tr>
<th>Sprayer type</th>
<th>Number of droplets/cm² at the levels of plant</th>
<th>Mean of droplets/cm²</th>
<th>(VMD) μm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td>Middle</td>
<td>Bottom</td>
<td></td>
</tr>
<tr>
<td>HV</td>
<td>92</td>
<td>67</td>
<td>19</td>
</tr>
<tr>
<td>LV</td>
<td>186</td>
<td>143</td>
<td>102</td>
</tr>
<tr>
<td>ULV</td>
<td>253</td>
<td>196</td>
<td>138</td>
</tr>
</tbody>
</table>

In case of the ULV applicator, relatively smooth reduction in droplet
number was noticed. Number of droplets reduced from 253 on the upper
leaves to 198 on the middle leaves representing 21.5% reduction. The
number of droplets on the lower leaves decreased to 138 droplets which
representing 45.5% reduction.

In case of LV applicator the decrease of the droplets number was more
obvious; since the droplets number ranged from 186 on the upper leaves to
143 on the middle leaves representing 23.1% reduction, and decreased to
102 droplets on the lower leaves representing 45.2% reduction. In the case of
HV applicator, this decrease was drastically; since the droplets number
decreased from 92 on the upper leaves to 67 on the middle leaves
representing 27.2% and decreased to 19 droplets on the lower leaves
representing 79.3% reduction.

From the same table, it can be noticed that the least VMD was
obtained using the ULV applicator (92 μm), followed by LV applicator with
(174 μm). The largest droplets (213 μm) resulted from HV applicator. In
general, data agree with finding of Awady and Alifi (1976).

The efficacy of the different tested fungicides was greatly affected with
the fungicides suspension amount per fed. Decreasing the fungicides
suspension amount resulted in clear reduction in the fungicides efficacy. However, this reduction depended upon the applicator type. This reduction was great in the case of HV applicator, intermediate in case of LV applicator and low in case of ULV applicator. Grayson et al. (1996) attributed the enhanced performance of fungicides by low volume applicator to the higher spray retention with spray drop coalescence and lower run-off. On the other hand, the number and size of the spray droplets per cm² reaching the crop or ground play their part in determining the biological efficacy of the treatment in addition to the efficacy of the fungicide (Anonymous, 1986). Similar data were obtained by Moustafa and Ismail (2003).

The amount of the indicator captured on the strips was high when HV applicator was used compared with LV and ULV. This higher amount may be due to the higher ability of the large droplets produced by the HV applicator to run off, resulting in little amount of indicator solution captured on the plant foliage and increased amount of the indicator that reached the soil. Brunskill (1958) discussed such suggestion; he mentioned that droplets, which reach a surface, might not be retained on it. He added that droplets which strike a surface become flattened, but the kinetic energy is such that the droplets then retract and bounce away. Droplets below certain size (< 150 μm) have insufficient kinetic energy to overcome the surface energy and viscous changes and cannot bounce; conversely, very large droplets have so much kinetic energy.

The potential for an LV applicator to improve the penetration and deposition of fungicides material within crop canopies lies within the sprayer turbulence and mass transfer characteristics.

Spray using HV applicator depend on the pressure of the hand pump. Also, the LV applicator works using air pressure with air velocity about 43.7 m/sec. The two sprayers produced large droplets compared with the ULV sprayer. Droplets of HV and LV penetrated the heavy growth plants with drag force by pressure and air velocity respectively. Meanwhile, spray using ULV applicator which works with centrifugal force produced very small fine droplets that have low speed. Therefore, it’s ability to interleave the heavy growth plants will not occur. Generally, droplet size had significant effect on deposition efficiency; however, it is important to note that its effect could be influenced by droplet velocity, spray quantity, leaf surface properties.

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التفاعل بين بعض المبيدات الفطرية والرش في مقاومة مرض البيضاء
في القمح

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لم يدق من هذا البحث دراسة التفاعل بين ثلاثة من المبيدات الفطرية الهماجية تنتمي لمجموعة الزيزاولول لتقاطع مع ثلاثة أنواع من آلات الرش ذات الطرز التكتية الكبيرة والطرز الصغيرة والطرز المزدوجة في الحفر. ثم تفيد هذه الدراسة بمحبطة الريشة الزراعية بالمغربة موسمي 2004/2005

قد أعطت المبيدات الفطرية إريهني (تيزيزاولول)، سومي - إيت (ديبكونزول) على قيم من الحفزة لمقاومة مرض البذور عند استخدام آلات الرش ذات الطرز الصغرية 97.00، 87.75، 93.63، 97.50، 95.60، 96.25، 94.10، 97.50، 92.75، 99.25 في عامي 2004-2005 على التوالي، بينما أظهر المبيدات عيني - إريهني (تيزيزاولول) أقل قيمًا للحزمة مع كل آلات الرش المستخدمة.

فقد أن التفاعل كان جيداً ومحلياً بين المبيدات وآلات الرش حيث أظهرت آلة الرش ذات الطرز الصغرية، آلة الرش ذات الطرز الكبيرة أقل تفتيش لدورة الإصابة بالمرض (100، 100، 100، 100) % على التوالي في عامي 2004-2005، بينما أظهرت الرشاعة ذات الطرز الصغرية أعلى متوسط دورة الإصابة بالمرض (53.33، 51.66، 51.16) % مقاومة مع تدخل الكتلور.

أظهرت الاستجابات المماثلة أن الرشاعة ULV التي تتخطى قطارات صغيرة جداً (UAV) (السيمي -56.8 ميكرومير) والرشاعة ذات الطرز الصغرية 183 قطارات طويلة 141 ميكرومير) بينما الرشاعة ذات الطرز الكبيرة تتخطى قطارات كبيرة (98 قطارات، قطارة 169 ميكرومير).

يعتبر الرش بالرشاعة ULV على ضفاف مساحة الإيواء والرشاعة HV على ضفاف HV الرياح بسرعة حوالي 43 م/ث. وقطر الطرز المزدوجة من الرشاعة HV، الرياح بقطرات عالية الذي تصل الطرز المزدوجة إلى 16 ميكرومير بواسطة قوة مفعول بالرياح وسرعة الرياح وفق章程. بينما الرش بالرشاعة HV التي تصل القطرات المزدوجة إلى قطارة 141 ميكرومير التي تتحت طرق صغيرة جداً مثل قطارة صغيرة لا تتحت دخل النباتات الكبيرة. هذه النتائج تشير إلى أهمية اختيار نوع الريشة المناسب للرجوع المحصول. نباتات ذات الرياح الكثيفة مثالية لписать محصول الرياح المكثف. نباتات ذات الرياح الكثيفة بهيئة (الإشعاع 300-350 م/ث) يجب أن ترش بالرشة لها قطارة طويلة للفترات HV (الإشعاع ULV) (الإشعاع 300-350 م/ث) يجب أن ترش بالرشة لها قطارة طويلة للفترات HV (الإشعاع ULV)