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## Studies on the Effectiveness of Spreader-Sticker Added Diniconazole Against Rust (*Phragmidium mucronatum* (Pers) Schlecht) on Oil-Bearing Roses in Isparta Province\*

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**Abstract:** In this study, the effect of diniconazole which is used to control of rose rust (*Phragmidium mucronatum*) was investigated by reducing the application number and lowering the dose by addition of a spreader-sticker (Citowett).

As a result, the following four doses and 3 application times (April 15+April 27+June 13) of each provided 100% control; recommended dose with spreader-sticker addition, recommended dose without spreader-sticker, half of the recommended dose with spreader-sticker, half of the recommended dose without spreader-sticker. Two application (April 15+April 27) with the recommended dose provided 90.79%, two application with half of the recommended dose provided 85.22%, two application with the recommended dose+spreader-sticker provided 93.72% and two spraying with half of the recommended dose+spreader-sticker provided 87.45% control. The effectiveness of the treatments performed at one application time (April 15 or April 27) was below 60%.

### Isparta İli ve Çevresindeki Yağ Güllerindeki Pas Hastalığı (*Phragmidium mucronatum* (Pers) Schlecht)'a Karşı Yayıcı-Yapıştırıcı Kullanımıyla Diniconazole'un Etkinliğinin Arttırılması Üzerine Araştırmalar

**Özet:** Bu çalışmada, gül pasına (*Phragmidium mucronatum*) karşı kullanılan diniconazole'un yayıcı-yapıştırıcı (Citowett) ilavesi ile dozun düşürülmesi ve ilaçlama sayısının azaltılmasının hastalığa etkisi araştırılmıştır.

Araştırma sonucunda, yayıcı-yapıştırıcı ilaveli ve ilavesiz tam ve yarı dozlar, 3 ilaçlama (15 Nisan+27 Nisan+13 Nisan) ile %100 etki sağlarken; 2 ilaçlama (15 Nisan+27 Nisan) tam doz uygulaması %90.79, 2 ilaçlama 1/2 doz uygulaması %85.22, 2 ilaçlama tam doz+yayıcı-yapıştırıcı uygulaması %93.72 ve 1/2 doz+yayıcı-yapıştırıcı uygulaması %87.45'lik etki göstermiştir. İki ayrı zamanda yapılan birer ilaçlama uygulamalarında (15 Nisan veya 27 Nisan) etki %60'ın altında bulunmuştur.

### Introduction

Rose is an ornamental plant from Rosaceae family which is also used in cosmetic industry. Annual rose oil production of the world is about 5200 kg, but the consumption of the world is 4000 kg. In Isparta vicinity, 362 tons of rose extract, 48 tons of leaven, 15 tons of shampoo, 10 tons of cream, 2 tons of perfume were produced in 1989. These rose products provide additional to Isparta economy of about 16 billion TL [1].

Rose diseases are among the important factors effecting rose oil yield and quality. Rose rust

[*Phragmidium mucronatum* (Pers) Schlecht] and powdery mildew (*Sphaerotheca pannosa* var. *rosae*) are the most common fungal diseases [2].

Rust on oil-bearing roses attack leaves, new spring shoots and grow abundantly on the pedicels, sepals and receptacles, especially when the flower bud is unopened. This infection results in flowers of poor quality.

Negative effects of the chemicals on nature and the cost of pesticides leded the researches on reduction in amount of used pesticides or number of applications. It was reported that some additive materials known as

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adjuvants increase the effectiveness and performance of the pesticides [1]. The aim of this study was to investigate the effect of adjuvant [Citowett (spreader-sticker)] addition to diniconazole (Sumi-Eight 5 EC) on reducing of dose and number of application against rose rust.

## Materials and Methods

The material of this study was a rose garden of 2 da in Gümüşgün Village in Keçiborlu-Isparta which was heavily effected with rose rust during last two years. The species of the study was *Rosa domescana* Mill. which is the most common oil-bearing rose in the vicinity. The chemicals used in the study and doses were as follows:

| Firm Name | Trade Name                     | Active Ingredient           | Doses                   |
|-----------|--------------------------------|-----------------------------|-------------------------|
| Koruma    | Sumi-Eight 5 EC                | Diniconazole                | 15 and 30ml/100 l water |
| Bayer     | Citowett<br>(Spreader-Sticker) | Alkylarypolyglycol<br>Ether | 25 ml/100 l water       |

The study was set up according to randomised block design with 17 characters and 3 replications (Table 1).

As shown in Table 1, 1, 2 and 3 applications with recommended dose and half of the recommended dose were performed at different times.

The first application was performed at 20–25 days before red colour of flower buds appeared, second

application was performed 10–15 days after the first application and third application was performed just after the harvest [3, 10].

For 1 application case, both the first and second application times were tried as different treatments to plot the suitable for application time. Evaluations were accomplished 10–15 days after the last application. 15 united leaves of annual shoots from 5 different place of each parcel were picked up for laboratory investigation. These leaves were evaluated by using a 0–3 scale [3].

Criteria for the scale are;

0 : No indications of rust pustules on any of leaflets of united leaves,

1 : 1–5 rust pustules exist on the leaflets of united leaves (slightly infested),

2: 5–10 rust pustules exist on the leaflets of united leaves (infested),

3: More than 10 rust pustules exist on the leaflets of united leaves (heavily infested).

Disease rates were obtained by using Townsend–Heuberger formula. The effectiveness rates of the chemicals was evaluated according to Abbott formula and analysis of variance was performed and differences among the groups were determined by using Duncan's multiple range test [4].

| No | Times of application | Treatments                | Doses<br>(100l <sup>-1</sup> water) |
|----|----------------------|---------------------------|-------------------------------------|
| 1  | April 15             | 1 appl., rec. d.          | 30 ml (Sumi-Eight)                  |
| 2  | April 15             | 1 appl., rec. 1/2 d.      | 15 ml (Sumi-Eight)                  |
| 3  | April 15             | 1 appl., rec. d.+adj.*    | 30 ml (Sum.)+25 ml (Cit.)           |
| 4  | April 15             | 1 appl., rec. 1/2 d.+adj. | 15 ml (Sum.)+25 ml (Cit.)           |
| 5  | April 27             | 1 appl., rec. d.          | 30 ml (Sumi-Eight)                  |
| 6  | April 27             | 1 appl., rec. 1/2 d.      | 15 ml (Sumi-Eight)                  |
| 7  | April 27             | 1 appl., rec. d.+adj.     | 30 ml (Sum.)+25 ml. (Cit.)          |
| 8  | April 27             | 1 appl., rec. 1/2 d.+adj. | 15 ml (Sum.)+25 ml (Cit.)           |
| 9  | April 15+27          | 2 appl., rec. d.          | 30 ml (Sumi-Eight)                  |
| 10 | April 15+27          | 2 appl., rec. 1/2 d.      | 15 ml (Sumi-Eight)                  |
| 11 | April 15+27          | 2 appl., rec. d.+adj.     | 30 ml (Sum.)+25 ml (Cit.)           |
| 12 | April 15+27          | 2 appl., rec. 1/2 d.+adj. | 15 ml (Sum.)+25 ml (Cit.)           |
| 13 | April 15+27+June 13  | 3 appl., rec. d.          | 30 ml (Sumi-Eight)                  |
| 14 | April 15+27+June 13  | 3 appl., rec. 1/2 d       | 15 ml (Sumi-Eight)                  |
| 15 | April 15+27+June 13  | 3 appl., rec. d.+adj.     | 30 ml (Sum.)+25 ml (Cit.)           |
| 16 | April 15+27+June 13  | 3 appl., rec. 1/2 d.+adj. | 15 ml (Sum.)+25 ml (Cit.)           |
| 17 | –                    | CONTROL                   | –                                   |

Table 1. Times of application, treatments and doses used in the study.

\* appl., rec. d. + adj.: application, recommended dose+adjuvant.

## Results

The results for the disease rates were given in Table 2, the percent effectiveness of chemical doses and Duncan test for interaction between application time and dose were given in Table 3.

Table 3 indicates that at the level of 0.05 and 0.01 average difference, 3 applications maintained 100% control for all doses. There was considerable difference between 3 applications and 2 applications. For 2 applications, there was considerable difference between recommended dose and recommended dose+adjuvant at the level of 0.05. The difference for the last case at the level of 0.01 was not considerable. There was considerable difference between 2 applications and 1 application at both 0.05 and 0.01 levels. The application time April 15 seemed more effective than April 27 for 1 application.

## Discussion

Since the *Phragmidium mucronatum* (Pers) Schlecht, the agent of rose rust on oil-bearing rose, is very

common every year at the Isparta vicinity, the chemical control has great importance.

Benadonil+Spreader–Sticker (Calirus 50 W+Citowett) maintained 11.1% control of *Phragmidium mucronatum* on *Rosa laxa* [4]. The most of the polymers that forms film on cucumber, tomato, bean and cut rose could prevent the grey mould (*Botrytis cinerea*) at green house conditions [5]. In this study even 2 applications with recommended dose+spreader–sticker reduced the disease growth rate to 4.98%; which was 10.07% for half of the recommended dose. These results confirm the results of some authors [5].

Some authors suggest 3 fungicide applications at different times [3, 7, 8, 9]. According to these investigations 3 applications with recommended dose and half of the recommended dose without spreader–sticker could maintain control of disease and this result was also conforming the above mentioned results.

Although the disease was thoroughly prevented by three applications, this success in controlling the disease might be correlated with environmental conditions and/or low disease rate (79.70%). As a matter of fact, some

Table 2. Disease rates (%) for chemical applications at different times.

| No | Times of application | Application number and doses (100l <sup>-1</sup> water) | Disease rates (%) |       |       | Mean  |
|----|----------------------|---|-------------------|-------|-------|-------|
|    |                      |   | 1                 | 2     | 3     |       |
| 1  | April 15             | 1 appl., rec. d.  | 37.78             | 38.66 | 36.28 | 37.57 |
| 2  | April 15             | 1 appl., rec. 1/2 d.                                    | 44.00             | 43.78 | 46.83 | 44.87 |
| 3  | April 15             | 1 appl., rec. d.+adj.*                                  | 33.78             | 31.11 | 34.22 | 33.04 |
| 4  | April 15             | 1 appl., rec. 1/2 d.+adj.                               | 43.72             | 40.89 | 40.44 | 41.68 |
| 5  | April 27             | 1 appl., rec. d.  | 52.88             | 53.46 | 52.00 | 52.78 |
| 6  | April 27             | 1 appl., rec. 1/2 d.                                    | 56.44             | 60.00 | 65.94 | 60.79 |
| 7  | April 27             | 1 appl., rec. d.+adj.                                   | 47.55             | 47.11 | 48.58 | 47.75 |
| 8  | April 27             | 1 appl., rec. 1/2 d.+adj.                               | 54.67             | 55.56 | 60.00 | 56.74 |
| 9  | April 15+27          | 2 appl., rec. d.  | 6.67              | 8.67  | 6.67  | 7.34  |
| 10 | April 15+27          | 2 appl., rec. 1/2 d.                                    | 10.22             | 11.56 | 13.33 | 11.70 |
| 11 | April 15+27          | 2 appl., rec. d.+adj.                                   | 4.58              | 4.58  | 5.78  | 4.98  |
| 12 | April 15+27          | 2 appl., rec. 1/2 d.+adj.                               | 9.78              | 11.11 | 9.33  | 10.07 |
| 13 | April 15+27+June 13  | 3 appl., rec. d.  | 0                 | 0     | 0     | 0     |
| 14 | April 15+27+June 13  | 3 appl., rec. 1/2 d.                                    | 0                 | 0     | 0     | 0     |
| 15 | April 15+27+June 13  | 3 appl., rec. d.+adj.                                   | 0                 | 0     | 0     | 0     |
| 16 | April 15+27+June 13  | 3 appl., rec. 1/2 d.+adj.                               | 0                 | 0     | 0     | 0     |
| 17 | –                    | CONTROL   | 74.67             | 79.11 | 85.33 | 79.70 |

\* appl., rec. d.+adj.: application, recommended dose+adjuvant.

Table 3. Percent effectiveness of the chemicals used in different applications times and Duncan test for interaction between application time and dose.

| No | Times of application | Application number and doses (100 l <sup>-1</sup> water) | Effectiveness (%) |       |       | Mean  | Angles corresponding to percentages | 0.05 | 0.01 |
|----|----------------------|--|-------------------|-------|-------|-------|-------------------------------------|------|------|
|    |                      |  | 1                 | 2     | 3     |       |                                     |      |      |
| 1  | April 15+27+June 13  | 3 appl., rec. d.   | 100               | 100   | 100   | 100   | 90                                  | A**  | A    |
| 2  | April 15+27+June 13  | 3 appl., rec. 1/2 d.                                     | 100               | 100   | 100   | 100   | 90                                  | A    | A    |
| 3  | April 15+27+June 13  | 3 appl., rec. d.+adj.                                    | 100               | 100   | 100   | 100   | 90                                  | A    | A    |
| 4  | April 15+27+June 13  | 3 appl., rec. 1/2 d.+adj.                                | 100               | 100   | 100   | 100   | 90                                  | A    | A    |
| 5  | April 15+27          | 2 appl., rec. d.+adj.                                    | 94.14             | 94.14 | 92.89 | 93.72 | 75.48                               | B    | BC   |
| 6  | April 15+27          | 2 appl., rec. d.   | 91.63             | 89.12 | 91.63 | 90.79 | 72.34                               | C    | CD   |
| 7  | April 15+27          | 2 appl., rec. 1/2 d.+adj.                                | 87.87             | 86.19 | 88.28 | 87.45 | 69.64                               | DE   | DE   |
| 8  | April 15+27          | 2 appl., rec. 1/2 d.                                     | 87.03             | 85.36 | 83.26 | 85.22 | 67.43                               | E    | F    |
| 9  | April 15             | 1 appl., recom. d.+adj.*                                 | 57.74             | 61.09 | 56.90 | 58.58 | 49.94                               | F    | F    |
| 10 | April 15             | 1 appl., rec. d.   | 52.72             | 51.46 | 53.39 | 52.86 | 46.64                               | G    | GH   |
| 11 | April 15             | 1 appl., rec. 1/2 d.+adj.                                | 45.19             | 48.54 | 49.37 | 47.70 | 43.68                               | HI   | HI   |
| 12 | April 15             | 1 appl., rec. 1/2 d.                                     | 44.77             | 45.19 | 41.42 | 43.79 | 41.44                               | IJ   | IJ   |
| 13 | April 27             | 1 appl., rec. d.+adj.                                    | 40.17             | 41.00 | 38.91 | 40.03 | 39.25                               | J    | J    |
| 14 | April 27             | 1 appl., rec. d.   | 33.47             | 33.05 | 34.73 | 33.75 | 35.53                               | K    | KL   |
| 15 | April 27             | 1 appl., rec. 1/2 d.+adj.                                | 31.38             | 30.13 | 24.69 | 28.73 | 32.38                               | L    | L    |
| 16 | April 27             | 1 appl., rec. 1/2 d.                                     | 29.29             | 24.69 | 17.15 | 23.71 | 29.02                               | M    | M    |

\* appl., rec. d.+adj.: application, recommended dose+adjuvant.

\*\* Numbers followed by the same letters are not significantly different (P=0.05 and P=0.01).

researchers obtained 90% and 80% success in disease control when disease rates were 95.1% and 95.6%, respectively [5, 9].

This study proved that performing the first application at the time suggested in previous publications [3, 9, 10] diniconazole with Citowett could provide 93.7% control by 2 applications and 87.45% control by using the half of the recommended dose. As seen in this study, an adjuvant increases the effect of fungicide and could reduce the application number and/or dose. There are no reports regarding resistance of *Phragmidium mucronatum* to diniconazole. However, if diniconazole is

used in long periods resistance may develop. Nowadays environmental pollution and residue problems depending on the excessive use of pesticides keeps increasing, so more detailed studies related with this subject should frequently be performed.

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