INTEGRATED MANAGEMENT OF RHIZOCTONIA CROWN AND ROOT ROT

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Introduction

Rhizoctonia crown and root rot occurs in every region that sugarbeets are grown. The disease is caused by a complex of Rhizoctonia solani 2-2 isg IV and isg III B, with the isg III B becoming more predominant in areas where corn is significant in rotations. In Montana, the isg IIIB isolate now makes up approximately 50% of isolations, whereas 10-20 years ago it was rare with most isolates being isg IV. Since the labeling of azoxystrobin (Quadris) in the mid 1990s growers have used post emergence banded and infurrow applications of this fungicide or products such as Headline, Gem or Proline. Efficacy of banded applications was greatly improved when researchers (Jacobsen, Khan) showed that applications must be made before soil temperatures at the 4 inch depth exceeded 65-70F and after soils at this depth were 60F, rather than a specific growth stage. However, timing for late planting or springs when soils warm up quickly was a problem or where growers often has a small window for optimal timing. In the last 15 years of Rhizoctonia work in MT, the period for optimal timing ranged from 3-17 days depending on the spring. Growers with large acreages frequently could not get optimal timing on all their acres. While Rhizoctonia resistant varieties are available, they frequently have lower yield potential, do not have a full component of other disease resistances such as Rhizomania, Curly Top, Aphanomyces, Fusarium Yellows, and Cercsopora and in our experience have also responded to properly timed fungicide applications with both increased yields and reduced disease severity.

This research was initiated to determine if a combination of seed treatments or infurrow fungicide application could be combined with banded fungicide applications such that growers would have a large window to apply banded fungicide applications and achieve a high level of control. Seed treatment fungicides will give some protection but alone do not provide satisfactory control. Infurrow fungicide applications have given inconsistent control with control being excellent in some years and poor in other years. In comparison, properly time band applications have always given the best control in our research and that of most others. Also based on our storage work with Rhizoctonia infected beets that demonstrated that even a small percentage of infected beets will result in severe decay)both Rhizoctonia and secondary bacteria and fungi), improved control of Rhizoctonia crown and root rot is needed. The importance of storage losses caused by Rhizoctonia has also been demonstrated by Campbell and Fugate who demonstrated that beets in the Rupple rating classes of 0,1,2 and 3 did not contribute significantly to storage problems while those roots in classes 4,5,6 and 7 cause significant storage losses.

The Rhizoctonia problem in MT appears to be increasing in severity. I believe the primary reason is that our most popular varieties are more susceptible than varieties of 5-10 years ago. Also, the dramatic increase of corn in the rotation is suspected to contribute to higher inoculum levels in fields particularly the isg IIIB strain.

Based on work by Windels and her group and work we published last year we again chose to closely examine penthiopyrad seed treatments as part of the package. We utilized penthiopyrad (Kabina) at 7 and 14 g/seed unit Infurrow work done by the Michigan group has indicated that infurrow applications of Quadris are effective and based on other work done in 2011 and 2012 we also evaluated Vertisan and Priaxor in addition to Quadris as in furrow applications . These treatments were either done alone or followed by Quadris band applications when soil temperatures reached 65F (4-6) or at the8-10 or 10-12 leaf stage. This work showed there was no difference in band application timing relative to disease control or yield if penthiopyrad seed treatment or infurrow sprays were used. Therefore in 2013 we used only Quadris applications at the 10-12 leaf stage to simplify plot design and provide growers the widest possible window for band application of Quadris.

Methods and Materials

Research was done at the Southern Agricultural Research Station at Huntley, MT. The soil type was a Yellowstone silty clay loam. The field was inoculated with 39 lb./A of Rhizoctonia infested barley using a fertilizer spreader and incorporated with a K tool 1 week before planting on May 3, 2013. Non-inoculated areas were achieved by tarpping the plot area during inoculum application and incorporation. Plots were planted with a Milton planter to achieve populations of ~30,000 plants per acre in 24 inch rows. A factorial split plot design with six replications was used with variety and post Quadris application as whole plots and preemergent treatments (seed treatments or infurrow fungicides) as split plots. Each plot was 3 rows, 30 ft. long with only the center row harvested. The varieties were BTS38RR*N (Rhizoctonia susceptible) and HM9344RR (Rhizioctonia moderately resistant). Quadris band applications were applied at the 10-12 leaf stage (July 7, 2013). Infurrow applications were done as a T-Band (`3") and band treatments were ~7" all done with a CO_2 sprayer at 7.5 gallon/A . Plots were irrigated by furrow irrigation as needed. Treatments are described in Table 1. Control seeds were treated with Poncho-Beta, Allegiance, Tachigaren (20 g/unit) and Maxim. Stands were counted at the 2 leaf stage and plants missing at harvest were given a rating of 7 on the Rupple scale. Harvest was done October 1-3, 2013. Each harvested root was rated on the Rupple 0-7 scale and tare, sugar and SLM data were done by Western Sugar. Rhizoctonia root ratings were normalized by conversion to a disease index to give values 0-100 with 0 equaling no disease and 100 completely rotted roots. Data analysis was done using analysis of variance and if significant means were separated using Fisher's protected least significant differences.

Table 1. Fungicide treatments and rates used in 2013 Integrated Experiments.

Fungicide	Seed Treatment	Infurrow-T Band (3")	Band 7"
Penthiopyrad 7 g/unit	x		
Penthiopyrad 14 g/unit	x		
Quadris 0.38 oz/1000 row ft		x	x
Priaxor 0.28 oz/1000 row ft		x	
Vertisan 1.2 oz/1000 row ft		x	

Results

Results are presented in Tables 2 and 3. The two varieties differed significantly with respect to disease index but did not differ with respect to tons/A or yield either with or without Quadris post application. Therefore of all other treatments and interactions the varieties were analyzed together. Quadris, Priaxor and Vertisan applied infurrow all reduced disease index and increased yield. Kabina seed treatments performed equal to the inoculated control. No treatment was equal to the uninoculated control.

When interactions with Quadris post applications are considered all treatments showed reduced disease index and increased yield with no treatment equaling the uninoculated control. Again all treatments benefiited form Quadris post applications. Quadris, Priaxor and Veritsan applied infurrow with a Quadris post were similar with respect to disease index and yield. Kabina seed treatment at 14 g/unit plus Quadris post performed statistically equal to the infurrow fungicides with respect to disease index and was equal to Quadris and Priaxor infurrow fungicides plus post Quadris with respect to yield. The Vertisan infurrow plus Quadris post treatment had the highest yield although statistically Quadris infurrow plus Quadris post and Priaxor alone or with Quadris post were equal in yield.

In terms of roots in the Rupple root rating 0-3 which should have lower storage losses, except for the Priaxor infurrow treatment, there was a lower percentage roots in the 0-3 classes for the susceptible BTS38RR8N when compared to more resistant HM9344RR. For the BTS38RR8N variety only Priaxor infuurow with or without Quadris band and Kabina 14 g + Quadris band had more than 50% roots on the 0-3 classes. Whereas for the more resistant HM9344RR, Quadris , Priaxor and Vertisan infurrow + Quadris band and Kabina 14 g seed treatment +Quadris band exceeded this 50% threshold. The 7g rate of Kabina was inferior in performance for roots in the 0-3 classes.

Conclusions

In three years of research the combination of penthiopyrad seed treatment at the 14 gram/kg seed and Quadris band application at 4-12 leaf stages provided reduced disease severity, equal to a properly time Quadris band treatment at the 4-6 leaf stage. In 2012 and 2013 this treatment also increased percentage of healthy roots and increased yields. When comparison are made only on penthiopyrad seed treatment rates there is no difference in the 14 and 28 gram /kg rates in 2011 nor in the 7, 14 or 28 gram rates in 2012 relative to disease control when combined with Quadris band treatment in 2013 the 14 gram rate was superior in performance compared to the 7 g rate . Vertisan or Quadris infurrow treatments worked relatively well alone in all three years but in 15 years of research Quadris infurrow treatments have failed in 5 years and in 2013 the Quadris infurrow treatment was barely acceptable. The infurrow plus band treatments at up to the 12 leaf stage provide good disease control. It should be pointed out that the 14g/kg seed rate is $1/200^{th}$ of the amount of fungicide as applied with the infurrow treatments. In 2013 the Priaxor infurrow treatment with or without Quadis post performed well. In all three years, the resistant variety had equal benefit from fungicide applications when compared to the susceptible variety. Growers should be excited about the prospects of a seed treatment that will allow them to apply band treatments at any time from the 4-12 leaf stages, allow approximately 3 weeks in these studies to apply a banded Quadris post treatment. Thus the combination of penthiopyrad seed treatment and Quadris band will allow a wider treatment window,l allow reduced fungicide use compared the the infurrow treatments and eliminates the need for addition of infurrow treatment equipment on the planter. In addition, penthiopyrad is a different mode of action fungicide compared to Quadris and this could be important in resistance management. It should be pointed out that all effective treatments are more effective on the resistant variety.

Table 2. 2013 Integration of Penthiopyrad seed treatment, infurrow fungicides and Quadris band applications for control of Rhizoctonia Crown and Root Rot at Huntley, MT.

Treatment Group	Quadris post @0.38 oz/1000 row ft @10-12 leaf	At plant fungicide Oz/1000 row ft Gram/unit seed trt	Disease Index 0-100	Ton/A	Extractable Sucrose lb/A
Variety					
BTS38RR8N			66.7a	21.7 a	4661 a
HM9344RR			59.4 b	22.2 a	4962 a
Quadris band					
BTS38RR8N	No		77.3 a	15.9 b	3403 b
BTS38RR8N	Yes		57.2 b	27.4 a	5919 a
HM9344RR	No		70.6 a	18.0 b	3804 b
HM9344RR	Yes		48.3 c	26.3 a	6119 a
Varieties analyzed together					
Uninoculated			14.8 c	37.7 a	9180 a
Inoculated			82.8 a	10.5 d	2050 c
Inoculated		Quadris 0.38	64.1 b	22.3 c	4984 b
Inoculated		Priaxor 0.28	57.4 b	27.5 b	5879 b
Inoculated		Vertisan 1.2	60.9 b	26.5 bc	5634 b
Inoculated		Kabina 7 g	82.8 a	14.2 d	2877 c
Inoculated		Kabina 14 g	78.8 a	14.7 d	3076 c
Quadris post X at plant fungicide interaction					
uninoculated	No		20.2 f	36.7 ab	8837 a
uninoculated	Yes		9.5 f	38.7 a	9522 a
inoculated	No		95.5 a	3.4 h	378 f
inoculated	Yes		70.2 bc	17.7 fg	3723 e
inoculated	No	Quadris 0.38	79.2 b	15.6 g	3508 e
inoculated	Yes	Quadris 0.38	48.9 e	29.0 cd	6460 bc
inoculated	No	Priaxor 0.28	64.4 cd	26.4 c-e	5597 b-d
inoculated	Yes	Priaxor 0.28	50.3 e	28.5 cd	6161 bc
inoculated	No	Vertisan 1.2	67.9 bc	21.9 e-g	4346 de
inoculated	Yes	Vertisan 1.2	53.9 de	31.1 bc	6922 b
inoculated	No	Kabina 7g	93.4 a	8.2 h	1370 f
inoculated	Yes	Kabina 7 g	72.2 bc	20.2 e-g	4383 de
inoculated	No	Kabina 14 g	93.6 a	6.6 h	1189 f
inoculated	Yes	Kabina 14 g	64.1 cd	22.8 d-f	4962 c-e

Means with in a treatment grouping and column folloed by a different letter are significantly different at the 0.05 probability level

Table 3. Percentage roots on Rupple classes 0-3 as affected by fungicide treatment on BTS38RR8N (Rhizoctonia susceptible) and HM9344RR (Rhizoctonia moderately resistant) as affected by Kabina seed treatment or infurrow fungicides with or without Quadris post applications at the 10-12 leaf stage.

Treatment- rates as in Table 2.	BTS38RR8N	HM9344RR
uninoculated	84.6 abc	81.2 a-d
Uninoculated + Quadris Band	96.3 a	94.7 ab
Inoculated	24.2 k-m	17.9 i-m
Quadris infurrow	23.1 j-m	45.5 e-j
Priaxor infurrow	55.2 e-h	46.2 e-j
Vertisan infurrow	29.1 i-m	48.5 e-j
Kabina 7 g seed treatment	14.4 m	24.3 i-k
Kabina 14 g seed treatment	20.0 k-m	24.0-k-m
Quadris infurrow + Quadris Band	32.6 j	57.7 e-j
Priaxor infurrow + Quadris Band	50.5 e-i	63.2 c-f
Vertisan infurrow+ Quadris Band	36.3 i-m	69.3 b-e
Kabina 7 g seed treatment +Quadris band	38.8 i-m	42.7 f-l
Kabina 14 g seed treatment + Quadris Band	53.4 e-i	53.8 e-i
Flsd 0.05	24.5	24.5

Means with in a treatment grouping and column folloed by a different letter are significantly different at the 0.05 probability level