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AgriLIFE EXTENSION
Texas A&M System

Agriculture and Natural Resources

Developing a Sampling Protocol and Economic Threshold for Pod Rot of Peanut

Texas AgriLife Extension Service

Texas AgriLife Research Service

Gaines and Terry Counties

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Summary

Pod rot of peanut is significant disease in the Texas South Plains. Producers and crop consultants have listed it as a major problem. Pod rot is difficult and time consuming to scout for, due to its clumped occurrence in fields. Producers who have a history of pod rot will make chemical treatments based on the calendar. Two fields were investigated in 2010 for the effects of applying fungicides either by calendar schedules, or by basing the applications on pod rot thresholds. Three calendar scheduled treatments were evaluated. The fungicides applied were either Abound FL (24.6 oz/acre) or Ridomil EC + Provost (8 + 10.7 oz/acre) banded over 20 inches. Three threshold treatments were evaluated: low = 1-2% pod rot; moderate=3-4% pod rot; and high=5-6% pod rot. Plots were laid out in a randomized complete plot design with three replications. Fields were sampled weekly by rating a total of 101 points divided among the 21 plots. At each point, 1.5 ft. of row was dug and the pods examined for rot. Pod rot for all fields in 2010 were primarily caused by *Pythium* sp., though *Rhizoctonia solani* was also present as well in both fields. The low threshold treatment has done very well in terms of yield in both 2009 and 2010, in spite of having more pod rot fungicide treatment than the calendar applications. If threshold levels of pod rot are used to time applications, we recommend the low threshold (1-2%) for the first application. Once pod rot begins to climb again (by 1-2%) than another application is recommended, but not before at least 21-28 days. To get an accurate estimate of pod rot in a field, it is better to choose 20 random points, and only dig up a small area in each point.

Objective

This project is designed to determine if we can more successfully treat pod rot when fungicide application are made based on disease threshold rather than by calendar dates. To achieve this goal, we must identify what if any thresholds are better for timing of fungicides than calendar treatments. The second objective of this study is to determine how many samples a consultant must take to successfully estimate the average percent of pod rot.

Materials and Methods

Two fields were investigated in 2010 for the effects of adding fungicides either by calendar scheduling, or by basing the applications on thresholds of pod rot. The thresholds were: low = 1-2% pod rot; moderate=3-4% pod rot; and high=5-6% pod rot. The fields were intensively scouted on a weekly schedule, starting just before the first calendar application. Plots were 8-rows wide, on 36-inch (Gaines co.) or 40-inch (Terry co.) row spacing. There were three replications for each treatment, and treatments were arranged in a randomized complete block design. Pod rot for all fields in 2010 were primarily caused by *Pythium* sp., though *Rhizoctonia solani* were also present as well in both fields. Fungicide applications were made with a spider spray rig and were timed to be applied as the pivot was starting in the test area. The fungicides applied were either Abound FL (24.6 oz/acre) or Ridomil EC + Provost (8 + 10.7 oz/acre) banded over 20 inches. Application times and cost for each treatment are in *Table 1*. Plot size in the Gaines County site ranged from 0.5 to 1.2 acres and 0.4 to 1 acre in the Terry County site.

Table 1. Treatments, application timing, and cost for each treatment in Gaines and Terry counties in 2010 at pod rot tests.

Gaines Co. Trts	Application Dates for Gaines County			$/acre Gaines Co.	Terry Co. Trts	Application Dates for Terry County		$/acre Terry Co.
A[1]/A/A	7 July	2 Aug.	5 Sept.	75.90	A/A	27 July	26 Aug.	45.52
A/R/A	7 July	2 Aug.	5 Sept.	101.14	A/R	27 July	26 Aug.	59.56
R[1]/R/A	7 July	2 Aug.	5 Sept.	106.87	R/R	27 July	26 Aug.	73.60
Low		2 Aug.	22 Aug.	66.22	Low			0
Med.		9 Aug.	12 Sept.	66.22	Med.			0
High		16 Aug.		40.92	High			0
None	-	-	-	0	None			0

[1]A=Abound FL applied at 24.6 oz/acre (20 inch bands) and R=Ridomil Gold EC + Provost applied at 8 and 10.7 oz/acre (20 inch bands).

Fields were sampled weekly by rating a total of 101 points divided among the 21 plots. At each point, 1.5 ft. of row was dug and the pods examined for rot. If there were any rotted pods, then the total number of pods and the number of rotted pods were counted. All rotted pods were placed in a bag and brought back to the laboratory. A number of pods were used to isolate the organisms associated with the rot. If pods were only marked superficially, then these were also counted and isolations were done. If *Rhizoctonia* or *Pythium* were isolated from a superficially marked pod, then these were also included in the "rot" category, otherwise, they were not counted towards the total percent rotted. All locations for sampling each week were determined ahead of time as random points within the field (without replacement) and their GPS locations were programmed into Garmin GPS receivers. People sampling went to their designated points each week to do the sampling. Each treatment had approximately the same number of samples taken, and more samples were taken from the longer rows than from the shorter rows.

A second objective of the study was to determine how many samples a scout should be taking in pod rot fields to adequately estimate the average pod rot. The total number of samples for each week was 101. The average from these samples, and a 95% confidence interval was calculated from both the two fields in 2010 and two fields sampled in 2009 (also in Gaines and Terry counties). Of the 101 samples, a random number generator was used to sample (at random) 5, 10, 15, 20, 25, 30, and 35 of the 101 points for each week. This random number simulation was run 10 times for each sampling number. The average % pod rot generated from each of these sampling numbers was calculated. The percent of times that the average was wrong (i.e. outside of the 95% confidence interval for the 101 samples) was calculated.

Results and Discussion

***Fungicide study*:**

Gaines County. The test area had a larger portion of pod rot located on the northwest side (Fig. 1). This affected the sampling estimates. Those plots that had a higher proportion of samples pulled from the more heavily diseased zones had higher pod rot averages each week. This caused the weekly sample averages to jump around more and it was harder to interpret as to whether the fungicide treatments were effective (Table 2). There was more pod rot overall in the low, medium, and high threshold treatments, and the untreated check than in the Abound FL (A/A/A) and Abound FL rotated with Ridomil + Provost treatments (A/R/A) (*Table 2*).

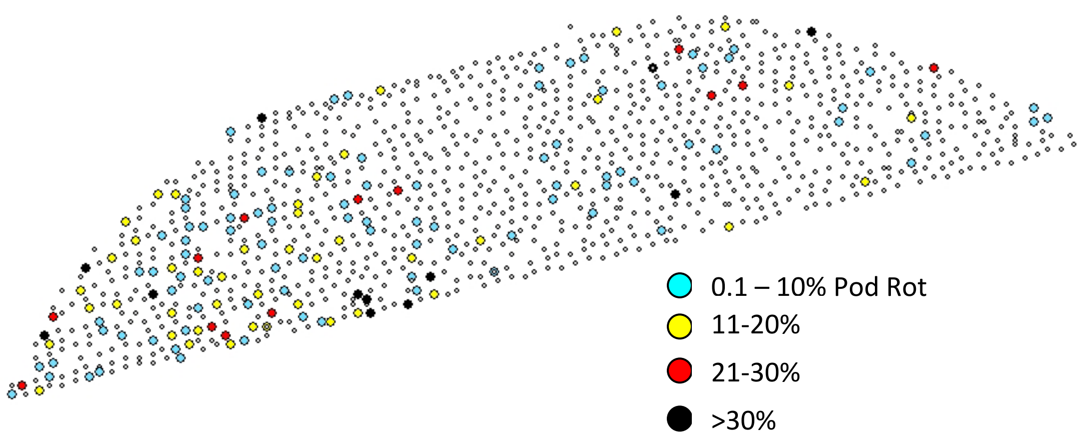

Figure 1. Location of areas with pod rot at the Gaines county field in 2010.

The Ridomil + Provost treatments (R/R/A) gave numerically higher pod rot than the calendar treatments that included Abound FL (*Table 2*). All three calendar treatments had less % diseased kernels at harvest than the threshold (low, mid, and high) and untreated check (*Table 3*). The grade was highest for the A/A/A treatment, and the value/ton ($/ton) was higher for the A/A/A and A/R/A treatments than for the low and mid threshold treatments (*Table 3*). There were no significant differences between treatments with respect to yield, yield x kernel value, and this term minus chemical costs (*Table 3*).

Table 2. %Pod rot from week 4 – 11 of scouting and average pod rot across these weeks, by calendar and threshold treatments at a Gaines county site.

Trt[1]	Combined For 8 weeks		% Pod rot for each trt on each week							
			4[2]	5	6	7	8	9	10	11
A/A/A	0.6	b	0	0.2	0	2.8	0.6	1.0	0.2	0
A/R/A	0.3	b	0	0	0	2.4	0.1	0.2	0.2	0
R/R/A	2.1	ab	0	0.1	4.3	1.0	8.2	1.9	0.8	0.5
Low	2.9	a	0.5	1.1	3.6	5.2	2.1	0.6	3.2	4.9
Mid	4.0	a	0.2	3.2	3.6	3.0	8.3	0.9	2.9	1.2
High	2.6	ab	0.2	1.6	4.6	4.1	1.6	1.2	12.1	6.6
None	3.1	a	1.0	1.8	6.8	1.8	1.1	6.1	3.5	2.5

[1]A=Abound FL; R=Ridomil Gold EC + Provost; Low=low threshold with applications at 1-2% pod rot; Mid=mid threshold with applications at 3-4% pod rot; High=high threshold with applications at 5-6% pod rot; None means no
[2]Week 4 was 27 July.

Table 3. Peanut yield, net return, and kernel characteristics for a fungicide test in Gaines County in 2010.

Trt[1]	Lbs/Acre (LA)	Value/ton (VT) ($)		LA x VT ($/acre)	LA x VT-chemical costs ($/a)	Grade	% DK[2]
A/A/A	5700	377	a	1076	1000	78.1 a	0.4 b
A/R/A	5233	374	a	978	870	76.6 b	0.3 b
R/R/A	5548	371	ab	1030	923	75.4 b	0.4 b
Low	6369	366	b	1167	1100	76.1 b	1.4 a
Mid	5302	366	b	971	905	75.4 b	1.3 a
High	4888	373	ab	910	869	76.7 b	1.1 a
None	5282	372	ab	983	983	76.4 b	1.1 a

[1]A=Abound FL; R=Ridomil Gold EC + Provost; Low=low threshold with applications at 1-2% pod rot;
[2]DK =damaged kernels.

Pythium was isolated at an equal frequency among all the treatments, while *Rhizoctonia* was more frequently isolated in the untreated check than for all fungicide applied treatments, except the mid threshold treatment. *Pythium* was isolated about twice as frequently as *Rhizoctonia* from pods, inspite of it being more difficult to isolate, because pods are completely rotted with Pythium pod rot and have a lot of bacteria and secondary fungal contamination. In general, Rhizoctonia pod rot is easier to isolate, so the frequency of *Pythium* to *Rhizoctonia* in this field was probably considerably more than 2:1.

Terry County. Pod rot at this site was low all season, so none of the thresholds were triggered for applications. The test collapsed into four treatments, two calendar applications for Abound FL, Abound FL rotated with Ridomil Gold EC + Provost, and two applications of Ridomil Gold EC + Provost, compared against no fungicide treatment. There were no differences in pod rot at any individual week of the sampling or in the combined analysis for all weeks (*Table 4*). There were no differences between treatments in yield, yield x kernel value, grade, or % damaged kernels (*Table 5*).

The frequency of isolation for *Pythium* or *Rhizoctonia* was not affected by the fungicide treatments. *Pythium* was isolated about 2.5 times more frequently than was *Rhizoctonia* from pods with rot symptoms.

Table 4. %Pod rot from week 2 – 9 of scouting and average pod rot across these weeks, by calendar and threshold treatments at a Terry county site.

Trt[1]	**Combined For 8 weeks**	**% Pod rot for each trt on each week**							
		2[2]	**3**	**4**	**5**	**6**	**7**	**8**	**9**
A/A	0.3	0	0.6	0.4	0	0	0.4	0.7	0.2
A/R	0.1	0	0.3	0	0	0.4	0	0	0
R/R	0.1	0	0.2	0	0	0	0.2	0.5	0
None	0.6	0.9	0.1	0.2	0.5	0.7	0.7	0.9	0.6

[1]A=Abound FL; R=Ridomil Gold EC + Provost; None means no fungicide
[2]Week 2 was 22 July.

Table 5. Peanut yield, net return, and kernel characteristics for a fungicide test in Terry county in 2010.

Trt[1]	**Lbs/Acre (LA)**	**Value/ton (VT) ($)**	**LA x VT ($/acre)**	**LA x VT-chemical costs ($/a)**	**Grade**	**% DK**[2]
A/A	5209	347	903	858	67.8	1.3
A/R	4930	345	850	790	67.2	1.2
R/R	5257	339	879	805	66.2	1.0
None	5055	334	857	857	65.3	1.0

[1]A=Abound FL; R=Ridomil Gold EC + Provost; None means no fungicide applications.
[2]DK =damaged kernels.

Sampling intensity for pod rot: The four fields sampled in 2009 and 2010 had very different patterns of pod rot. The Terry County field in 2010 (Moore 2010) had very low levels of pod rot, the Gaines County field (Grissom) in 2010 had moderate levels of pod rot, and the two fields in 2009 (Grissom and Mason) had high levels of pod rot (*Fig. 2*).

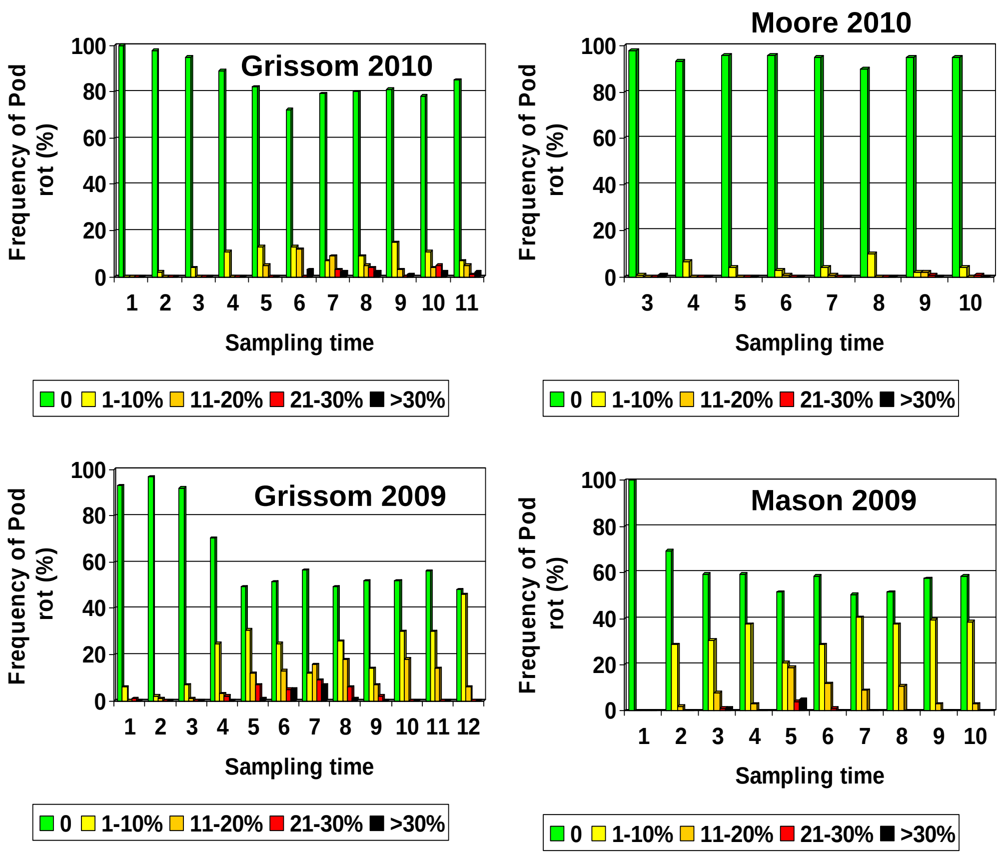

Figure 2. Frequency of pod rot samples taken in Gaines (Grissom 2009 and 2010) and Terry (Mason 2009 and Moore 2010) counties. Pod rot was grouped into 0, 1-10%, 11-20%, 21-30%, and >30% categories.

The Terry County field in 2010 had low levels of pod rot all season, and it didn't matter how many or few samples were taken to estimate the average of pod rot accurately. For the other sites, taking samples at 20 randomly selected locations meant that at least 67% of the time, the pod rot estimate was within a 95% confidence interval for the mean estimated by taking 101 samples. Taking only 15 samples meant that in at least one field, only 56% of the time was the average pod rot estimated in the field accurate, and sampling only 10 locations (probably closest to what consultants actually do) over 50% of the time, the pod rot estimate was incorrect. An example of what 5, 20, and 35 samples looks like for the T09 field is seen in *Figure 3*.

Table 6. Relationship between sampling intensity at four peanut fields and the percentage of times that the sample estimate of pod rot was incorrect.

N[1]	% of times the sample average for pod rot was incorrect[2]			
	G09[3]	G10	T09	T10
5	43	64	79	26
10	30	49	53	18
15	28	30	44	18
20	20	24	33	23
25	12	24	28	18
30	8	15	19	24
35	3	15	14	6

[1]N is the number of samples selected at random in the peanut field out of a total of 101 samples that were taken at each sampling time during the season.

[2]A sample average was incorrect if the mean fell outside of the 95% confidence intervals constructed around the mean when 101 samples were taken at each sampling time during

[3]G09 and G10 were fields in Gaines County and T09 and T10 were fields in Terry County.

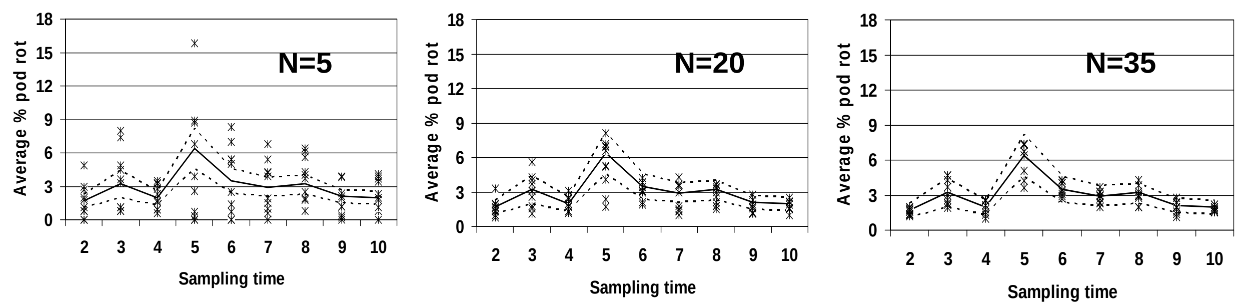

Figure 3. Average pod rot (solid line) based on 101 samples taken in the Terry County peanut field in 2009. The dotted lines are the 95% confidence intervals based around the mean and standard deviation from the 101 samples. The *'s are based on random samples taken at either 5, 20, or 35 locations in the field each time the field in sampled. The random sampling pattern was conducted 10 times (10 *'s per sampling week). If the * is located outside of the dotted line, then the average pod rot estimated from that sampling number (5, 20, or 35) was incorrect and a wrong management decision could be implemented if sampling estimates are poor. With 5, 20, and 35 samples, the wrong estimate was obtained 79, 33, and 14% of the time, when averaged over all sampling times.

<u>Conclusions</u>

In both years, there has been less pod rot in the plots treated with calendar applications of fungicides, rather than using thresholds. This is true even for the low threshold of 1-2% pod rot. The first calendar application goes out well before the first threshold application. However, this has not translated into significant gains in yield. The low threshold treatment has done very well in terms of yield in both 2009 and 2010, in spite of having more pod rot than the calendar application treatments. If threshold levels of pod rot are used to time applications, we recommend the low threshold (1-2%) for the first application. Once pod rot begins to climb again (by 1-2%) than another application is recommended, but not before at least 21-28 days.

The sampling number recommended for consultants was detailed above, and we are currently recommending taking 20 samples at random in a field. The Gaines co. field in 2010 had a higher frequency of pod rot in the NW edge than the rest of the field. If a consultant tried to “cheat” on the sample number by taking fewer samples, but digging up more row feet at a spot, that strategy would create problems in fields like the Gaines County 2010 field. If pod rot is distributed random around the field, then the strategy of visiting fewer spots, but digging up more plants would probably be fine. The Gaines County field in 2009 had a fairly random distribution of pod rot, and a scout was as likely to find pod rot in the next foot of row as the next random point. However, with the Gaines county field in 2010, if the scout was in the NW side, then the next foot of row had a higher chance of having pod rot than a random point somewhere else in the field. Also, in the rest of the field, the next foot of row was more likely to be healthy than a random point, which might fall in the NW part of the field. So, to get an accurate estimate of pod rot in a field, it is better to choose 20 random points, and only dig up a small area in each point.

Acknowledgements

Special thanks to Jimbo Grissom and Alan Bayer for cooperating with us on this project. This project was funded by the Texas Peanut Producers Board.

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