ORIGINAL ARTICLE

Reaction of peanut cultivars to late leafspot and rust

Viboon Pensuk[1], Aran Patanothai[2], Sanun Jogloy[3], Sopone Wongkaew[4], Chutipong Akkasaeng[5] and Nimitr Vorasoot[6]

Abstract

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Late leafspot caused by *Phaeoisariopsis personata* (Berk. & M.A. Curtis van Arx) and rust caused by *Puccinia arachidis* Speg. are among the most serious diseases of peanut. Although fungicide application is effective in controlling the diseases, its high cost is considered uneconomical in many developing countries. In this situation, the use of resistant cultivars offers a better alternative. The objective of this study was to evaluate seven peanut cultivars for their resistances to late leafspot and rust. Peanut cultivars were planted in a randomized complete block design (RCBD) with 4 replications at Khon Kaen University Experimental Farm. Natural infection of late leafspot and rust were allowed. Disease score, sporulation index and lesion number per 100 cm^2 of leaf area were recorded as the resistance parameters of both diseases. Pod yield, seed yield, shelling percentage, pod number per plant and pod length were also measured. NC 17135 was the most resistant to late leafspot and moderately resistant to rust. NC 17090 was the most resistant to rust but susceptible to late leafspot. NC 17135 and NC 17090 should be recommended as sources of late leafspot and rust resistance, respectively. The two Thai released cultivars, Tainan 9 and Lampang were highly susceptible to both diseases.

Key words : plant disease resistance, *Arachis hypogaea* L., *Phaeoisariopsis personata, Puccinia arachidis*, agronomic traits, peanut

[1]Ph.D. (Plant Breeding), [2]Ph.D. (Plant Breeding), Prof., [3]Ph.D. (Plant Breeding), Assoc. Prof., [5]Ph.D. (Plant Physiology), Asst. Prof., [6]Ph.D. (Climatology and Plant Physiology), Assoc. Prof., Department of Agronomy, Faculty of Agriculture, Khon Kaen University, Khon Kaen, 40002, [4]Ph.D. (Plant Pathology), School of Crop Production Technology, Institute of Agricultural Technology, Suranaree University of Technology, Nakhon Ratchasima 30000 Thailand.
Corresponding e-mail : sanun@kku.ac.th
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บทคัดย่อ

วิบูล เป็นสุข[1] อารันต์ พัฒโนทัย[1] สนั่น จอกลอย[1] โสภณ วงศ์แก้ว[2] ชุติพงศ์ อรรคแสง[1] และ นิมิตร วรสูต[1]

ปฏิกิริยาของพันธุ์ถั่วลิสงต่อโรคใบจุดสีดำและโรคราสนิม

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โรคใบจุดสีดำ ซึ่งเกิดจากเชื้อราสาเหตุ *Phaeoisariopsis personata* และโรคราสนิม ซึ่งเกิดจากเชื้อราสาเหตุ *Puccinia arachidis* เป็นโรคที่สำคัญของถั่วลิสง การใช้สารเคมีควบคุมสองโรคนี้ ถึงแม้จะได้ผลดี แต่ก็เป็นการเพิ่มต้นทุนสำหรับการผลิตถั่วลิสง ดังนั้น การใช้พันธุ์ถั่วลิสงที่ต้านทานโรคจึงเป็นวิธีการป้องกันกำจัดที่ดีกว่า งานทดลองนี้มีวัตถุประสงค์เพื่อประเมินระดับความต้านทานของถั่วลิสง 7 พันธุ์ต่อโรคใบจุดสีดำ และโรคราสนิม ในสภาพไร่ทดลองของมหาวิทยาลัยขอนแก่น โดยใช้แผนการทดลองแบบ randomized complete block design (RCBD) มี 4 ซ้ำ ปล่อยให้โรคทั้งสองระบาดตามธรรมชาติ แล้วประเมินลักษณะความต้านทานต่อโรค คือ คะแนนการเป็นโรค ดัชนีการสร้างสปอร์ และจำนวนแผลต่อพื้นที่ใบ 100 ตร.ซม. และบันทึกข้อมูลลักษณะทางการเกษตร คือ ผลผลิตฝัก ผลผลิตเมล็ด เปอร์เซ็นต์การกะเทาะ จำนวนฝักต่อต้น และความยาวฝัก จากการศึกษาพบว่า พันธุ์ NC 17135 เป็นพันธุ์ที่ต้านทานสูงต่อโรคใบจุดสีดำ และมีความต้านทานปานกลางต่อโรคราสนิมส่วนพันธุ์ NC 17090 มีความต้านทานสูงต่อโรคราสนิม แต่ค่อนข้างอ่อนแอต่อโรคใบจุดสีดำ ควรใช้พันธุ์ NC 17135 และพันธุ์ NC 17090 เป็นพันธุ์แนะนำเพื่อเป็นแหล่งของความต้านทานต่อโรคใบจุดสีดำ และโรคราสนิมตามลำดับ ส่วนพันธุ์ที่ให้ผลผลิตสูงของประเทศไทยสองพันธุ์ที่ใช้ทดสอบในครั้งนี้ คือพันธุ์ไทนาน 9 และพันธุ์ลำปาง พบว่า อ่อนแอต่อทั้งโรคใบจุดสีดำ และโรคราสนิม

[1] ภาควิชาพืชไร่ คณะเกษตรศาสตร์ มหาวิทยาลัยขอนแก่น อำเภอเมือง จังหวัดขอนแก่น 40002 [2] แผนกวิชาเทคโนโลยีการผลิตพืช สำนักวิชาเทคโนโลยีการเกษตร มหาวิทยาลัยเทคโนโลยีสุรนารี อำเภอเมือง จังหวัดนครราชสีมา 30000

Late leafspot caused by *Phaeoisariopsis personata* (Berk & M.A Curtis van Arx) is widely distributed throughout the world. Late leafspot can cause yield losses up to 80% (Grichar *et al*., 1998 ; McDonald *et al*., 1985 ; Miller *et al*., 1990). Peanut rust incited by *Puccinia arachidis* Speg. is another economically important disease in almost all peanut growing areas of the world (Subrahmanyam and McDonald, 1987). Yield losses from rust are over 50% (Subrahmanyam *et al*., 1980). Fungicide application is an effective method to control the diseases but most of the farmers in developing countries cannot afford to buy the fungicide. The alternative way is to identify resistant peanut germplasm and incorporate the resistance into adapted cultivars. The objective of this research was to compare seven peanut cultivars for their resistances to late leafspot and rust diseases under field conditions.

Materials and Methods

Rust and late leafspot resistance and agronomic traits evaluation

Seven peanut cultivars, GP-NC 343, NC 9, Lampang, NC 17135, Tainan 9, Chico and NC 17090 (Table 1) were planted at Khon Kaen University Experimental Farm in a randomized complete block design with four replications. Seeds were treated with fungicide and planted in twenty five seeded rows, double rows plots with 30 cm between plants within row and 50 cm between rows. Normal cultural practices were followed during the growing season. No foliar fungicide was applied to allow natural infection of late leafspot and rust. From previous records for years, peanuts in the experimental farm were predominantly infected by late leafspot and rust and only a light infection of early leafspot was observed. At 80 days after sowing, rust and late leafspot were

Table 1. Peanut cultivars used in this study and some of their characteristics

Cultivar	Characteristic
GP-NC 343	Virginia botanical type, early leafspot (*Cercospora arachidicola*) resistance.
NC 9	Virginia botanical type, high yielding, early maturing cultivar from North Carolina, USA.
Lampang	Valencia botanical type, high yielding, boiling type peanut from Thailand.
NC 17135	Valencia botanical type.
Chico	Spanish botanical type, small-seeded, early maturity.
Tainan 9	Spanish botanical type, high yielding, multipurpose peanut from Thailand.
NC 17090	Valencia botanical type

Table 2. The 9-point field scale for late leafspot and rust assessment (Subrahmanyam *et al*., 1995)

Late leafspot	Score	Rust
No disease	1	No disease
Few, small necrotic spots on older leaves	2	Few, small necrotic spots on older leaves
Small spots, mainly on older leaves, sprase sporulation.	3	Few pustules, mainly on older leaves, some ruptured, poor sporulation
Many spots, mostly on lower and middle leaves, disease evident.	4	Pustules small or large, mostly on lower and middle leaves, disease evident
Spots easily seen on lower and middle leaves, moderately sporulating, lower leaves	5	Many pustules, mostly on lower and middle leaves, yellowing and necrosis of some lower and middle leaves, moderately sporulating
As rating 5 but spots heavily sporulating.	6	As rating 5 but pustules heavily sporulating.
Disease easily seen from a distance ; spots present all over the plant ; lower and middle leaves defoliating.	7	Pustules all over the plant ; lower and middle leaves withering
As rating 7 but defoliation is more severe	8	As rating 7 but withering is more severe
Plants severely affected, 50-100% defoliation.	9	Plants severely affected, 50-100% leaves withering

scored according to Subrahmanyam *et al*., (1995) as summarized in Table 2. Ten leaves per plot were sampled from the third leaf on main stem of each plant for disease resistant parameter laboratory evaluation. The disease resistant parameters were determined on sampled leaves as follows :

1) Total number of lesions per leaf for each disease.
2) Sporulation index based on visual rating, a scale of 1-5 for late leafspot with 1 indicating very little sporulation and 5 indicating heavy sporulation. For rust, the percentage of sporulating lesion was recorded.
3) Leaf area in cm^2 was measured by a leaf area meter and was used to estimate lesion number per 100 cm^2 of leaf area (= total number × 100/ leaf area)

For agronomic traits evaluation, ten plants were harvested from each plot at maturity. Peanut pods were dried to approximately 8% seed moisture and the following traits were determined :

1) Pod number per plant.
2) Dry pod weight (g/plant).
3) Pod length (average from 10 pods).
4) Seed weight (g/plant)
5) Seed size (g/100 seeds) and
6) Shelling percentage (seed weight × 100/ pod weight)

Statistical analyses

Analysis of variance was performed on all rust and late leafspot resistant parameters and agronomic traits. Duncan's multiple range test was used to detect the differences between means and simple correlation coefficients were computed between all possible pairs of rust resistant parameters and pairs of late leafspot parameters.

Results and Discussion

Late leafspot resistance

Significant genotypic differences were found for all resistance parameters (Table 3). Genotypes differed significantly in mean disease score, NC 17135 had the lowest disease score followed by NC 17090 while Tainan 9 and Lampang had the highest disease scores. Differences in sporulation between genotypes were significant. The NC 17135 had the lowest sporulation followed by GP-NC 343 while the two susceptible cultivars, NC 9 and Chico, had the highest indices. There were highly significant differences between genotypes in numbers of lesions per 100 cm^2 of leaf area. NC 17135 had the lowest lesions number per 100 cm^2 of leaf area while the most susceptible cultivar was Chico. NC 17135 exhibited a high resistance to late leafspot. It had the lowest disease score and lesion number per 100 cm^2 of leaf area and least sporulation. NC 17135 was reported as the best parent for late leafspot resistance (Jogloy *et al*., 1999 a). All of the commercial cultivars, NC 9, Tainan 9 and Lampang, were highly susceptible.

Rust resistance

Rust reactions of seven peanut cultivars are shown in Table 4. Cultivars tested responded differently to rust for all parameters except sporulation. NC 17090 had the lowest disease score followed by NC 17135, while the three susceptible cultivars, Chico, Tainan 9 and Lampang, had the highest disease scores. Difference in sporulation between genotypes was not significant. The differences between cultivars in number of lesion per 100 cm^2 of leaf area were highly significant. NC 17090 had the lowest lesion number per 100

Table 3. Reaction of seven peanut cultivars to leafspot under field conditions at Khon Kaen University Experimental Farm

Cultivar	Disease score[1/]	Sporulation[2/] index	Lesion number/100 cm^2[2/] of leaf area
GP-NC 343	4.25^{c}	2.13^{d}	76.32^{a}
NC 9	5.13^{bc}	3.63^{ab}	74.89^{a}
Lampang	6.57^{a}	3.25^{abc}	73.34^{a}
NC 17135	3.28^{d}	1.85^{d}	14.81^{b}
Tainan 9	6.60^{a}	2.93^{c}	65.95^{a}
Chico	6.38^{ab}	3.83^{a}	85.52^{a}
NC 17090	4.15^{c}	3.08^{bc}	67.96^{a}
F-test	**	**	*
C.V. (%)	7.4	8.2	10.9

***,** significant at P≤ 0.05 and 0.01, respectively.**
[1/] **a scale of 1-9 with 1 indicating no disease and 9 indicating severe disease damage.**
[2/] **a scale of 1-5 with 1 indicating very little sporulation and 5 indicating heavy sporulation,** means within a column **followd by the same letter are not significant at P = 0.05 by DMRT**

Table 4. Reaction of seven peanut cultivars to rust under a field conditions at Khon Kaen University Experimental Farm

Cultivar	Disease score[1/]	Sporulation[2/] (%)	Lesion number/100 cm[2/] of leaf area
GP-NC 343	1.92[b]	49.77	24.15[cd]
NC 9	2.10[b]	52.56	8.19[de]
Lampang	4.75[a]	58.45	40.52[bc]
NC 17135	1.77[b]	47.25	6.15[e]
Tainan 9	4.55[a]	68.18	144.89[ab]
Chico	5.13[a]	51.81	128.14[a]
NC 17090	1.75[b]	29.42	3.72[e]
F-test	**	NS	**
C.V. (%)	12.5	20.4	23.9

NS, *, not-significant and significant at P < 0.05 and 0.01, respectively.**
1/ a scale of 1-9 with 1 indicating no disease and 9 indicating severe disease damage.
2/ the percentage of sporulating lesions on the leaves.
means within a column followd by the same letter are not significant at P = 0.05 by DMRT

Table 5. Yield and agronomic traits of seven peanut cultivars evaluated under field conditions at Khon Kaen University Experimental Farm

Cultivar	Pod yield (g/plant)	Seed yield (g/plant)	Shelling percentage (%)	Pod no/ plant	Pod length (cm)	100-seed wt (g)
GP-NC 343	18.20[ab]	12.83[abc]	69.15[b]	17.00[bcd]	2.50[c]	49.89[ab]
NC 9	20.83[ab]	14.90[ab]	66.21[c]	19.10[bc]	2.54[c]	52.92[a]
Lampang	15.02[bc]	11.36[abc]	73.35[a]	21.95[ab]	1.99[e]	31.69[de]
NC 17135	20.30[ab]	14.58[ab]	70.39[b]	12.63[d]	3.91[a]	45.25[b]
Tainan 9	21.30[a]	15.84[a]	73.28[a]	28.52[a]	2.06[d]	37.86[c]
Chico	11.98[c]	9.13[c]	75.69[a]	21.20[ab]	1.89[f]	27.67[e]
NC 17090	14.90[bc]	10.51[bc]	69.66[b]	14.08[cd]	2.65[b]	33.65[cd]
F-test	*	*	*	**	**	**
C.V. (%)	7.5	8.5	1.2	7.1	0.9	2.5

***,** significant at P≤ 0.05 and 0.01, respectively.**
means within a column followd by the same letter are not significant at P = 0.05 by DMRT

cm^2 of leaf area followed by NC 17135, while the most susceptible cultivars were Tainan 9 and Chico. The two Thai released varieties, Tainan 9 and Lampang, were highly susceptible while NC 17090 exhibited a consistently high resistance to rust for all resistant parameters. An earlier report demonstrated that NC 17090 was the best parent for rust resistance (Jogloy *et al*., 1999 c). NC 17135 also showed low disease score and lesion number per 100 cm^2 of leaf area. Jogloy *et al*. (1999 b) reported that additive gene effect was important for rust disease score and lesion number per 100 cm^2 of leaf area in the progenies of cross NC 17135 × Tainan 9.

Agromomic traits

Yield and agronomic traits of seven peanut cultivars are shown in Table 5. Two released

cultivars, NC 9 and Tainan 9, gave the highest pod and seed yields followed by the late leafspot resistant cultivar, NC 17135. Tainan 9 also had the highest pod number per plant while Tainan 9 and Chico were among the top cultivars for shelling percentage. A previous report showed that Tainan 9 was the best parent for pod number per plant and shelling percentage (Jogloy *et al*., 2000). Among the tested cultivars, NC 17135 had the longest pod. All the released varieties, NC 9, Tainan 9 and Lampang, showed good yield and agronomic traits. NC 17135 was most resistant to late leafspot and exhibited favourable yield and agronomic traits. The most rust resistant line, NC 17090, tended to have lower yield and pooer agronomic traits.

Correlation

Moderate to high correlations among late leafspot resistance parameters were observed. Similar results were found on the rust resistance (Table 6). Among late leafspot resistant parameters, correlation coefficients between disease score and sporulation, and disease score and lesion number were moderatly to highly correlated. Less sporulation and fewer lesion number genotypes tended to have lower disease scores. The correlation study also showed that sporulation and lesion number were moderately correlated. Less sporulation cultivars tended to have fewer lesion number. Similar results were obseved for parameters of rust resistance, revealing that disease resistance genes of each parameter were associated. A similar finding was also reported by Kormsa-art *et al*., (2002).

Table 6. Phenotypic correlation coefficients for the parameters of late leafspot and rust resistance

Parameter	Sporulation index	Lesion no./100 cm^2 of leaf area
Late leafspot		
Disease score[1/]	0.65	0.83
Sporulation index[2/]		0.65
Rust		
Disease score[1/]	0.70	0.63
Sporulation[3/]		0.72

[1/] **a scale of 1-9 with 1 indicating no disease and 9 indicating severe disease damage.**
[2/] **a scale of 1-5 with 1 indicating wery little sporulation and 5 indicating heavy sporulation.**
[3/] **the percentage of sporulating lesion.**

In this study, the finding that NC 17135 was most resistant to late leafspot but was moderately resistant to rust and showed favourable agronomic traits and should be recommended as a source of resistance to late leafspot and rust. NC 17135 was also reported to be moderately resistant to both pathogens (Subrabmanyam et. al, 1982). NC 17090 was most resistant to rust but was susceptible to late leafspot. NC 17090 should be recommeded as a source of rust resistance. The two Thai released cultivars, Tainan 9 and Lampang were highly susceptible to both diseases.

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