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Severity of Sclerotinia Blight of Peanuts as Detected By Infrared Aerial Photography[1]

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ABSTRACT

The severity of *Sclerotinia sclerotiorum* as detected on aerial infrared photography was correlated with actual yield losses in the field. Peanut pod losses in the soil increased as disease severity became more pronounced as determined by imagery interpretation. In areas of fields on the imagery interpreted to be slightly, moderately and severely infected with *S. sclerotiorum*, pod losses due to infection were 2, 5 and 7 times greater, respectively, than normally expected losses in nondiseased areas (ca. 300 kg/ha). Sclerotial populations were 10 times greater in soil from severely infested areas on the field than from slightly and noninfested areas.

In 1976 Sclerotinia blight, caused by *S. Sclerotiorum* (Lib.) de By. (*S. minor*) Jagger (12), was a major disease of peanuts (*Arachis hypogaea* L.) in Virginia. Severity of infection ranged from none to severe within the same field. Although this soilborne disease was only recently observed in Virginia (9), it now occurs in most areas where peanuts are commercially grown in the state (11). *S. sclerotiorum* attacks all parts of the peanut plant. A characteristic feature of this disease is a loss of pods in the soil which results in yield reductions. A few fungicides are available which provide some control of Sclerotinia blight (1, 8). All commercially grown peanut cultivars are susceptible to *S. sclerotiorum (10).*

Aerial photography has long been used to detect plant diseases. Diseases of cereal crops (2, 3), citrus trees (7), forest trees (6), potato (5), sugarbeets (13), peanuts (11) and beans (15) have been detected on infrared imagery. However the relationship between detection of disease symptoms on infrared imagery and on-ground disease severity has received little attention although the potential has been recognized (2, 14). Recent research (13, 15) has demonstrated that a high correlation exists between infrared photographic estimates of disease severity and visual on-ground disease estimates.

In September of 1976 a large portion of Southampton County, VA was photographed using infrared film. The imagery was scanned and peanut fields having Sclerotinia blight were located. Five fields, each characterized by having at least one area severely infected with *S. sclerotiorum*, were then selected for intensive study. Our main objective was to correlate apparent severity of Sclerotinia blight on infrared imagery to actual yield losses in the field.

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Materials and Methods

Peanut fields located in Southampton County, Virginia were photographed from a twin-engine aircraft on September 24, 1976. The flight was conducted at an altitude of 3,811 meters above main sea level. Vertical imagery was collected using an RC-8 aerial mapping camera having a focal length of 152.4 mm. Infrared false color reversal film was used with a 12 AV/525 CC filter. The imagery was collected between 1104 and 1311 eastern daylight time. The film format was positive transparencies 22.86 x 22.86 cm. The approximate scale of the imagery was 1:25,000.

Five commercial peanut fields, each having at least one area with plants moderately to severely infected with *S. sclerotiorum*, were located on the infrared imagery. Approximately 14 days following peanut harvest (November 3 and 4), diseased areas in each field were identified. Within each field 4 to 6 sites (1.8m x 4.3m each) were randomly chosen in areas characterized by different disease severity levels as detected on the imagery. From each site, pods remaining in the soil after harvest were recovered with a specially designed salvage implement (4). This tractor-mounted implement was designed to recover in excess of 90% of the pods that were present in the top 10 cm of soil. Pods from each site were dried to a seed moisture content of approximately 10% and debris (vines, empty pods, etc.) was removed. Samples were then weighed and yeilds were determined. Air-dried soil (four 100 g samples/site taken with a 2.54 cm soil tube at a depth of up to 10 cm) was collected at time of pod recovery operations and screened over both a 20 mesh sieve to remove large-sized debris and a 35 mesh sieve to remove sclerotia. Sclerotia were removed by hand from the debris retained by the 35 mesh sieve and counted.

Results and Discussion

The severity of *S. sclerotiorum* on peanuts as detected by aerial infrared photography was correlated with actual pod losses in five peanut fields (Fig. 1). Foliage of infected areas is characterized by shades of gray. Healthy peanut foliage is characterized by a reddish coloration. Based on appearance, disease severity ratings of none, slight, moderate or severe were assigned to selected areas within each field (Table 1). Pod recovery rate from the soil was greater in areas where plants were severely infected (Fig. 1, areas labeled "b") than from areas with plants having less infection (Fig. 1 areas labeled "a"). As Sclerotinia blight symptoms became more pronounced on the imagery, pod losses increased accordingly. Pod losses were about 2, 5 and 7 times greater in areas of fields where Sclerotinia blight symptoms were slight, moderate and severe, respectively, than in areas of the field where plants were not infected with *S. sclerotiorum* (Table 1). In three areas where plants were classified as being severely infected with *S sclerotiorum*, pod losses exceeded 2000 kg/ha. In one field almost 2400 kg pods/ha were recovered from the soil where plants were severely infected (Fig. 1, 3B). In areas where plants were classified as being moderately infected, over 1500 kg pods/ha were recovered from the soil. Over 900 kg pods/ha were recovered from areas where plants were slightly infected. The rate of recovery of pods from areas where plants were not infected (300 kg/ha) was similar to that previously described for disease-free peanut fields (4).

Pod losses and subsequent yield reductions due to

Table 1. Severity of Sclerotinia blight of peanuts determined from aerial infrared photography

Field identity	Disease severity[1/]	Pods[2/] recovered (kg/ha)	Disease[3/] loss ratio	Soil[4/] sclerotia (No.)
1a	Slight	898[5/]	2.3	1.2
1b	Moderate	1628	4.9	9.3
2a	Slight	1021	2.7	1.4
2b	Severe	1890	5.8	8.2
3a	Slight	786	1.8	0.1
3b	Severe	2357	7.5	11.3
4a	None	392	0.5	0.0
4b	Moderate	1432	4.1	8.8
5a	None	263	-	1.9
5b	Severe	2037	6.4	11.4

1/ Severity of disease based on appearance of field as determined from infrared photographs.

2/ Pods recovered from top 10 cm of soil with a mechanical salvager.

3/ Total pods recovered minus normally expected loss divided by normally expected losses.

4/ Sclerotia per 100 g of soil.

5/ Numbers are averages of pod recoveries from 4 to 6 sites within a field area characterized by different disease severity levels.

infection by *S. sclerotiorum* can become severe in peanut fields. Field 2 (Fig. 1) is severely infested with *S. sclerotiorum*. Based on the number of pods recovered from the soil of severely infested areas and areas where the disease was less severe, it was estimated that in excess of 2800 kg of pods were lost in this 2 ha field. Based on the recovery rate of pods from severely infested areas and areas having less infestation in Field 1 (Fig. 1), it was estimated that over 3300 kg of pods were lost in this 4.86 ha field. Pod losses of this magnitude are indicative of the economic importance of Sclerotinia blight to Virginia peanut growers.

An abundance of sclerotia (1 sclerotum per 10 g soil) was found in soil of areas where plants were severely infected with *S. sclerotiorum* (Table 1). As disease severity decreased, the number of sclerotia found in the soil decreased. Sclerotia are thought to be the overwintering propagules of *S. sclerotiorum* in Virginia. Since sclerotia of *S. sclerotiorum* are known to persist for several years in the soil, the number existing in diseased peanut fields would insure infection in succeeding peanut crops.

Only recently has information become available regarding the assessment of disease losses using infrared photography. A high correlation between estimates of disease losses using infrared photography and visual on-gound estimates was recently reported for blackroot of sugarbeet (13) and bacterial blight of field beans (15). This study demonstrates that aerial infrared photography provides a quick and accurate method for determining an estimate of peanut yield reductions due to infection by *S. sclerotiorum*. Symptom detection on aerial infrared photography and the knowledge of actual pod losses known to be associated with a specific disease classification (slight, moderate, or severe) can provide a more precise methodology for estimates of yield losses caused by *S. sclerotiorum*.

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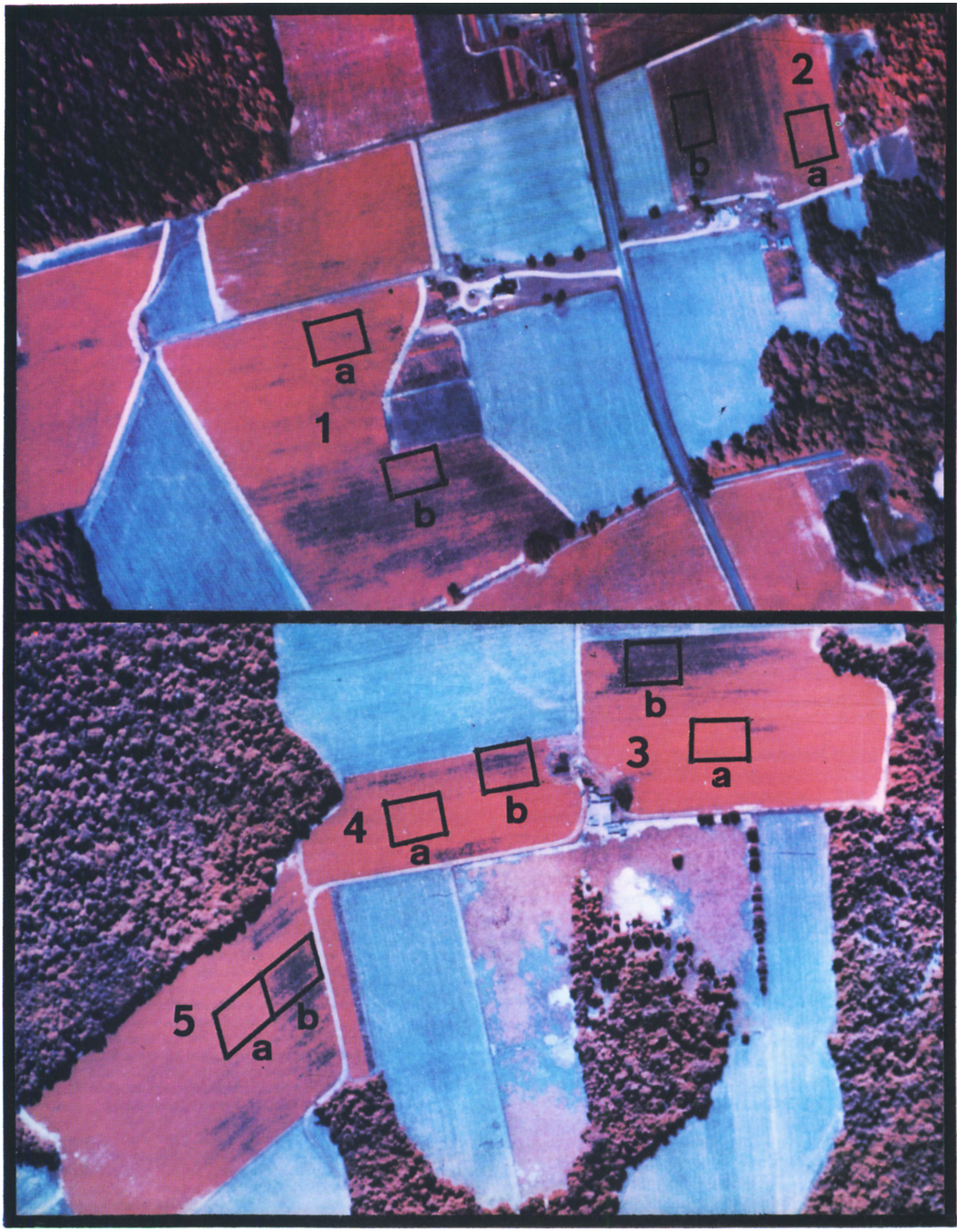

Fig. 1. Aerial infrared photography of five peanut fields (labeled 1 through 5) infested with *Sclerotinia sclerotiorum*. Blocks within each field labeled "a" and "b" represent different levels of disease severity within each field.