The Black Grass Bug (*Labops hesperius* Uhler): Its Effect on Several Native and Introduced Grasses

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Highlight: Large areas of Utah's rangeland have been seeded to introduced wheatgrasses, and many of these areas are now infested with the black grass bug (*Labops hesperius*). A study of the effects of this insect pest on several native and introduced grasses was conducted on three experimental study plots in southwestern Utah. The data revealed that the six introduced grass species studied, growing in small monocultures, contained considerably more black grass bugs than did the native range grasses in nearby areas. Thus, the six monoculture grass species were more susceptible to grass bug damage than were the native range grasses. Moreover, variations in black grass bug populations within the six grass monocultures also revealed differences in susceptibility. Phenology comparison data revealed there was no correlation between the phenological stage of plant development and the stage of black grass bug instar development, therefore ruling out an accurate means of determining time of spraying in relation to plant maturation.

About 89% of Utah is considered rangeland (Nielsen 1967). Large areas of this rangeland have been seeded to grasses for livestock forage and watershed stabilization. Much of the spring-fall range in southern Utah has been seeded to introduced wheatgrasses, and many of these seeded areas are now infested with the black grass bug (*Labops hesperius* Uhler). This insect pest damages range grasses, especially in early spring. Stockmen indicate that the palatability of the infested grasses is greatly reduced.

The life cycle and habits of all species of *Labops* are not completely known, but it has been reported that there are five nymphal instars before the bug reaches the adult stage (Todd and Kamm 1974) (Fig. 1). Slater (1954) reported that the life cycle of *Labops* is completed in one season, with the insects overwintering as eggs.

Black grass bugs have piercing, sucking mouth parts, and the damaged areas develop a yellowish to whitish mottled effect on the leaf surface marked with small black fecal spots. According to Markgraf (1974), the bugs puncture the plant cell walls and extract the liquid cell content removing much of the plant's "photosynthetic material."

The black grass bug problem was first recognized when large fields and vast rangelands were planted to mono-

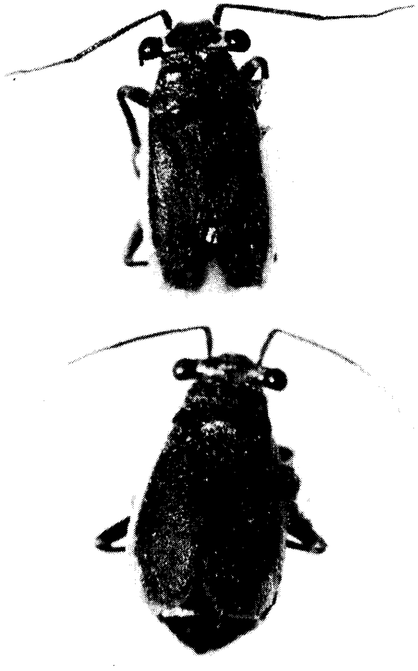

Fig. 1. *Adult* Labops hesperius*: (upper) male and (lower) female.*

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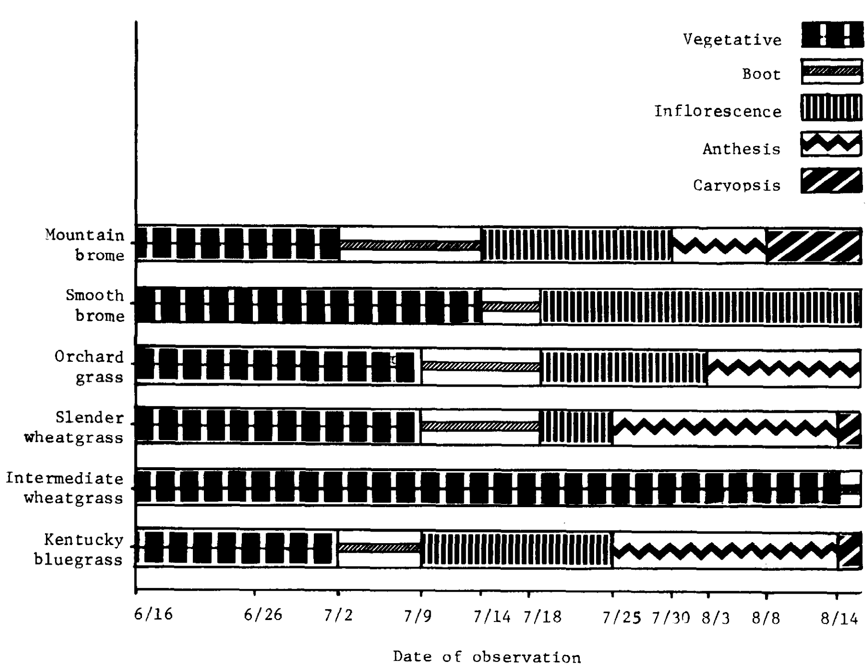

Fig. 2. *Phenological stages of the grass species studied at Deer Valley study plot on 11 dates during 1973.*

cultures of crested wheatgrass (*Agropyron desertorum*) and other introduced grasses. Early observations of grass bugs in Utah were made between 1925 and 1943 by Knowlton (1971). In some areas of Utah, grass bug populations have been as numerous as 100 to 1,000 in a single clump of grass (Haws et al. 1973; Knowlton 1967). Knowlton (1967) reported a reduction in forage growth in Garfield County in Utah of over 60%. Many species of grasses have been damaged by black grass bugs, and Hewitt et al. (1974) reported that grass species and varieties vary in susceptibility to damage.

The damaged plant material is not attractive feed for livestock, but usually the infested grass will again become green, grow, and produce additional feed in late summer, after the insects have completed their life cycle (Jensen 1971; Knowlton 1966a).

Knowlton (1966b) reported that for effective control, insecticides should be applied after the eggs have hatched in the spring, and before the adults lay eggs.

Study Areas and Methods

Three study plots, each measuring 69 m × 36.6 m, were selected on Cedar Mountain in the Dixie National Forest in southwestern Utah, and studies were conducted during the summer of 1973. The Deer Valley study plot was located in Iron County near State Highway 14 east of Cedar City at an elevation of 2,926 m; the Dry Valley plot in Kane County at an elevation of 2,743 m; and the Long Valley plot in Iron County near Cedar Breaks National Monument at an elevation of 3,170 m.

In the fall of 1965, six species of native and introduced grasses including intermediate wheatgrass (*Agropyron intermedium*), slender wheatgrass (*Agropyron trachycaulum*), smooth brome (*Bromus inermis*), mountain brome (*Bromus polyanthus*), orchardgrass (*Dactylus glomerata*), and Kentucky bluegrass (*Poa pratensis*) were seeded in parallel rows in a randomized block design at each study plot. Native vegetation in the surrounding plant community was dominated by Lettermans needlegrass (*Stipa lettermanni*), sheep fescue (*Festuca ovina*), and mountain muhly (*Muhlenbergia montana*) and served as a "control." The native vegetation of this area has been characterized by Bowns (1972). Each plot was fenced to exclude livestock.

Each plot was divided in half, and half of each of the grass species and the control was randomly selected and fertilized with ammonium nitrate at the rate of 116.6 kg N/ha. Fertilizer was applied in the late autumn of 1972 with a cyclone seeder.

Malathion (57% E.C.) was applied at the rate of 584.8 ml/ha to each plot on one-half of the fertilized and one-half of the nonfertilized portions of the plot throughout the summer of 1973, thus making four treatments within each of the six grass species and control, creating a total of 28 experimental units. Premeasured amounts of the spray were mixed with water and applied to the plots with a hand pump sprayer. Black grass bug populations were monitored, and when the population increased, the spray was again applied to the treatment areas to control the bugs. In Deer Valley, Malathion was applied on three dates, June 22, July 10, and again on August 2. In Dry Valley, the insecticide was sprayed on June 26 and on July 10. Insecticide was applied in Long Valley on two dates, July 9 and August 2.

Grass plants were collected at regular intervals throughout the summer of 1973, to study the phenology and to get an approximation of the damage that had occurred (Fig. 2). Two plants were collected on each date from each of the 28 experimental units within the three study plots. The two plants were selected so as to be characteristic of that experimental unit. Plants were collected by cutting them at ground level. Then the plants were placed in a plant press, dried, mounted, and labeled.

Populations of black grass bug were collected in two ways. The fourth and fifth instars and adults were collected by taking three sweeps per experimental unit, using a .38-m diameter insect sweep net. The sweep net was positioned at ground level and a sweep of approximately 180 degrees was taken. The samples were immediately placed in paper sacks to be counted and preserved in alcohol. The first three instar nymphs were collected individually by hand with a small paint brush and vial of alcohol because of their extremely small size.

At peak production, in early September, grass samples were collected from each of the 28 experimental units. Ten quadrats (0.186 m^2) were clipped to ground level in each of the 28 experimental units. The harvested samples were weighed. An air-dry weight value was obtained for each grass species and field weights were adjusted to an air-dry weight basis. Forage production data were subjected to analysis of variance in a 2×2×7 factorial design with 10 replications.

Results and Discussion

Phenology of Black Grass Bug

The eggs, which over-wintered under the snow, began to hatch in mid-June, about 1 week after the snow had melted. Hatching periods varied among the study plots, as well as within each individual study plot. Apparently several factors, other than the time of snow melt, affect the period when eggs begin to hatch and the length of time until hatching is completed. Haws et al. (1973) were of the opinion that the eggs may hatch in the late fall or during warm periods in the winter if the eggs are first exposed to cold temperatures. These nymphs may then be able to survive in grass crowns if snow and cold weather return.

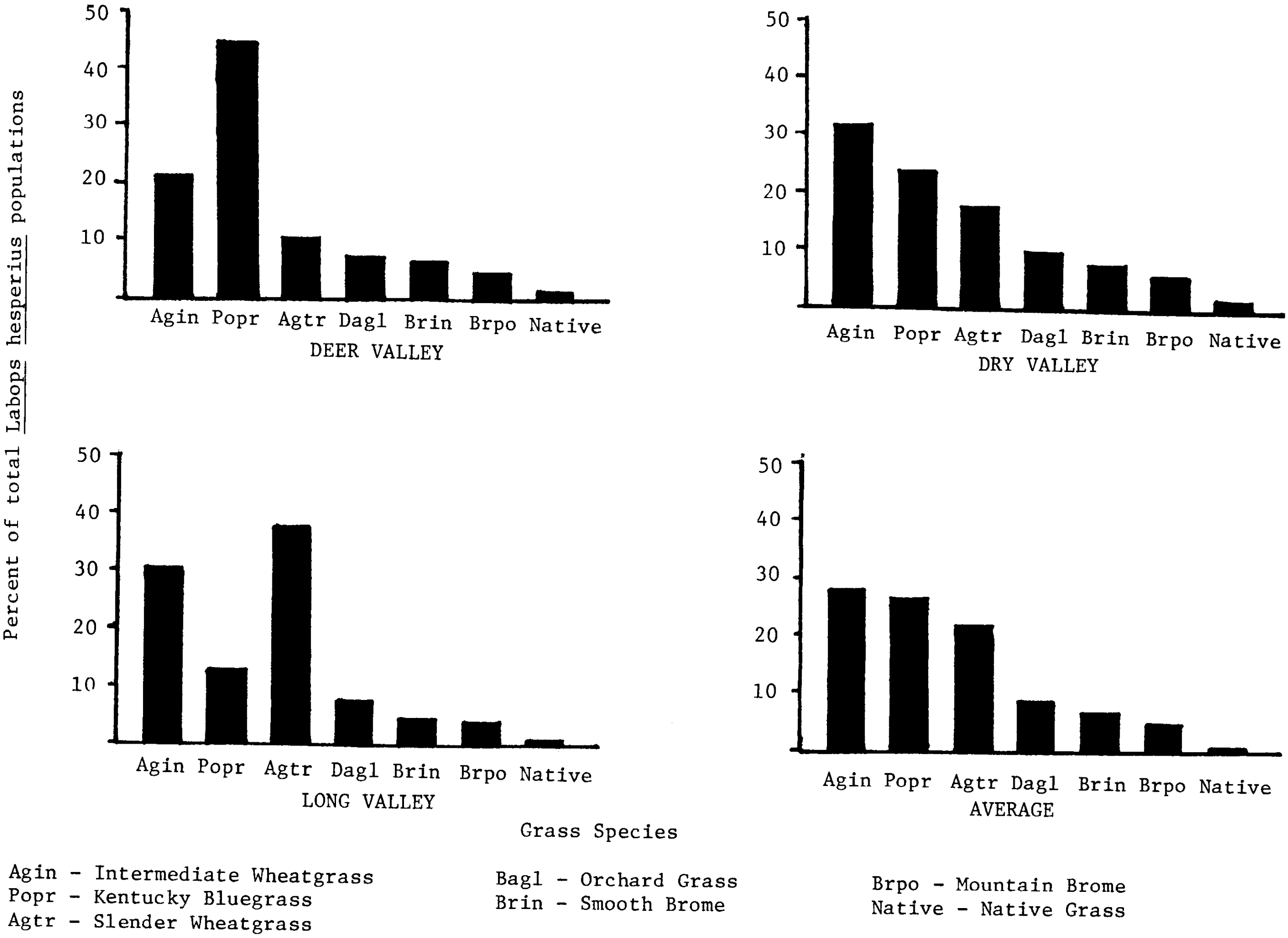

Fig. 3. *Percent of total* Labops hesperius *per 12 sweeps per grass species on each of 10 dates at each study plot during 1973 disregarding treatment areas.*

It was observed that approximately 2 weeks were required for nymphs to develop from hatching eggs to third instar nymphs, and approximately 4 weeks were required for the black grass bug to develop from newly-hatched first instar nymphs to adults.

Comparison Between Black Grass Bug and Grass Development

From detailed investigation of grass and bug phenology at the Deer Valley plot it was observed that the nymphal stage of development corresponded to the vegetative stage of grass phenology in four of the six grass species. However, by the time the adult bugs appeared, there was no longer any correlation between grass and bug phenologies. Moreover, there was considerable intraspecific variability in maturation of the grass plants. Because of this variation in phenological development, there would be no way to determine the stage of black grass bug instar development by examining the phenological stage of the grasses. Therefore, a meaningful control program of the black grass bug would have to be undertaken by directly observing the development of the bug and as Knowlton (1966b) suggested, spraying with insecticide after the eggs hatch in the spring, and before the bug matures to the adult stage and begins laying eggs.

Grass Species Susceptibility

Kentucky bluegrass, intermediate wheatgrass, orchardgrass, and smooth brome have previously been reported to be infested by black grass bug (Bohning and Currier 1967; Todd and Kamm 1974). Slender wheatgrass has also been reported to have infestations by Charles J. Brandt (1966) in his Administrative Study of *Labops hesperius* in the Cuba Ranger District in Santa Fe National Forest, New Mexico.

Throughout the course of this study, differing degrees of susceptibility to damage were evident among the grass species. The infested plants turned a yellow spotted color, making it obvious which species within the plot were being fed on most heavily. Because the plots were relatively small, the grass bugs had easy access to all grass species.

Most male black grass bugs have well-developed meso- and metathoracic wings, but the metathoracic wings of a high percentage of females are brachypterous (short-winged). Flying did not appear to be a significant means of locomotion for the insect. However, the insects were able to move very rapidly on the ground as well as through the litter and grass crowns.

The degree of infestation within all grass species varied from plot to plot, but definite trends could be observed. Figure 3 shows percentages of the total number of black grass bugs collected throughout the summer in each of the different grass species, disregarding the variables of the insecticide and fertilizer treatments (since all grass

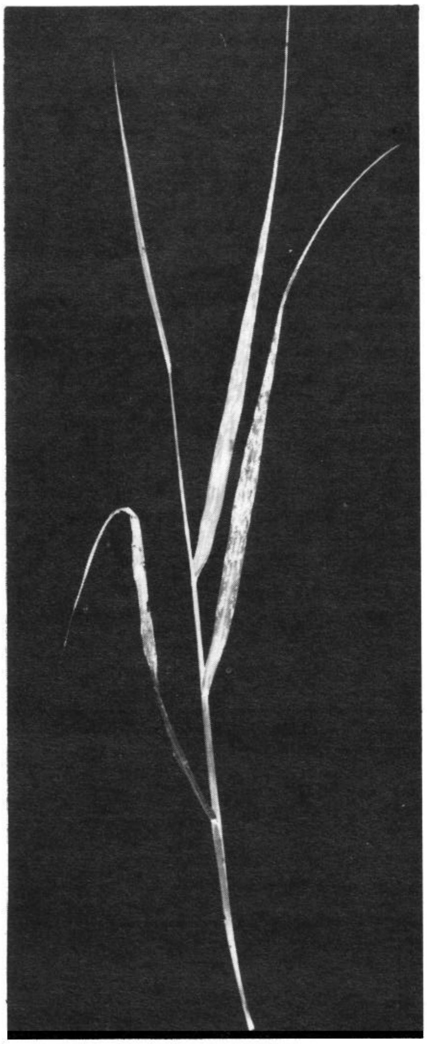

Fig. 4. *Intermediate wheatgrass from Deer Valley study plot during 1973 showing maximum* Labops hesperius *damage denoted by whitish areas on leaf surfaces.*

species were treated equally). The wheatgrasses and Kentucky bluegrass were the species most heavily infested by the bugs. The other grass species studied, in all three study plots, were ranked fourth, fifth, sixth, and seventh in every instance (Fig. 3). In general, the six seeded species supported much higher numbers of bugs than did the native grass species in the control portions of the study plots. For example, the overall average of the three plots showed that slender wheatgrass supported 47 times more bugs, intermediate wheatgrass 40 times more bugs, and bluegrass 28 times more bugs than did the native grasses.

These results support observations made by Jensen (1971) in the Dixie National Forest and also Hewitt et al. (1974) concerning damaging effects to rangelands which are seeded to monocultures of range grasses. On the native ranges black grass bugs are not usually present in numbers sufficiently large to cause heavy damage.

Forage production data showed some interesting results with respect to black grass bug populations. For example, mountain brome ranked first in forage production in Deer Valley, seventh in forage production in Dry Valley, and sixth in forage production in Long Valley; but at all three plots, it consistently ranked sixth with respect to black grass bug populations. This, along with similar findings as each grass species was observed in relationship to bug numbers, suggested that the susceptibility of the grass species is not related to the quantity of grass present.

The grass samples taken were carefully studied one by one, and Figures 4 and 5 show a representative of the maximum amount of damage within the experimental study plots and the least damage accumulative over the entire 1973 season, respectively. The whitish mottled areas on the surface of the leaves characterize the damage done by the grass bug.

Response of Black Grass Bug Populations to Fertilization

Fertilizer was applied initially to determine its effects on forage production, crude protein, and gross energy content of the plants. It was thought that the beneficial effects on these parameters would enable the plants to withstand the damaging effects of the bug.

The fertilized treatments of the study plots were visible because of the darker green color of the grass as compared to the nonfertilized treatments. Forage production data showed that the fertilized treatments produced significantly more forage than the nonfertilized treatments, as expected. It was also shown that the interaction between the fertilized treatment and grass species was significant at the 5% level of probability for the Deer Valley and Dry Valley plots. It appears that some grass species respond better to the fertilizer treatment than others.

The fertilized treatments also supported higher population densities of black grass bug than did the nonfertilized treatments. It was found that there were 25% more bugs in the fertilized treatments. Cook (165) reported that with proper nitrogen fertilization, cattle utilization of range forage was significantly higher. The authors hypothesized that fertilizer might increase the palatability of the plants to the bugs.

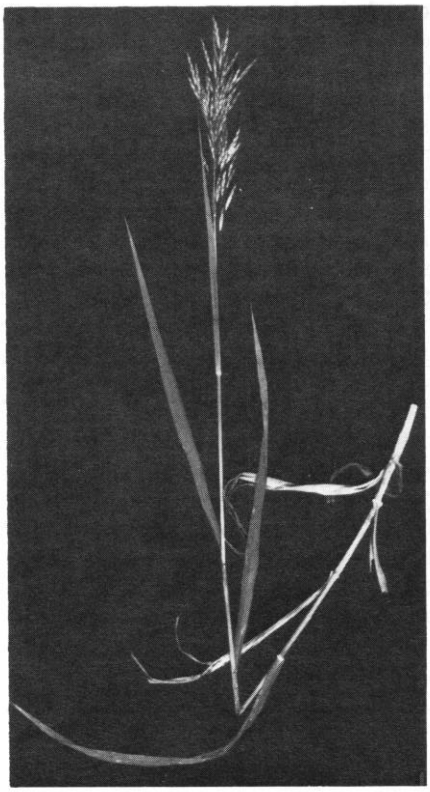

Fig. 5. *Mountain brome from Deer Valley study plot during 1973 showing maximum* Labops hesperius *damage denoted by whitish areas on leaf surfaces.*

Response of Black Grass Bug Populations to Insecticide Spraying

The insecticide was applied at a time of day and in such a manner as to minimize drift from one area to another. The drift effect was monitored and none was detected during the time of application. Insect populations were sampled the day following spraying, and there was essentially 100% control of the bugs in the sprayed treatments. Also, several days following the application of the Malathion, the numbers were reduced greatly in the nonsprayed treatment. It was concluded that spray drift did not kill the insects in the nonsprayed treatments, but that the rapid movement of the bugs enabled many in the nonsprayed treatment to come in contact with the spray in the sprayed treatment. This phenomenon was probably exaggerated in this study because of the small plot size.

Conclusions

Variability in phenological development of the grass species masked any correlation between black grass bug damage and the developmental stage of the plant or the bug. In these small monocultures, the six seeded grass species were infested with greater numbers of bugs than were the native range grasses. Using the differences in bug populations and the amount of injury to the grasses as criteria of susceptibility, the grasses ranked in the order of greatest to least susceptibility as follows: intermediate wheatgrass, Kentucky bluegrass, slender wheatgrass, orchardgrass, smooth brome, mountain brome, and the native grasses at all three study plots. Higher black grass bug densities were observed in the fertilized than in non-fertilized treatments, indicating an increased susceptibility following nitrogen fertilizer applications. Malathion applied at a rate 584.8 ml/ha proved to be an excellent means of controlling the black grass bug.

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Multiseasonal-multispectral Remote Sensing of Phenological Changes for Natural Vegetation Inventory, by Barry James Schrumpf, PhD, Rangeland Resources. 1975.

The advent of the Earth Resources Technology Satellite system (ERTS) brought with it the prospects of multispectral and multiseasonal views of the earth. The imaging capabilities of the system have provided current and repetitive pictures of the earth of such scale, extent, and detail as to reveal surficial features in a manner that was heretofore unavailable.

The repetitive aspects of the system's operations enable two significant capabilities: (1) monitoring changes occurring on the earth's surface and (2) identifying surficial subjects through recognition of characteristic chronological patterns of change that are repeated both in time and space. This latter capability was explored for the purpose of discriminating kinds of natural vegetation.

A test site in southern Arizona was selected which contained a wide variety of vegetation, including Sonoran and Chihuahuan desert shrub, desert grassland, savanna-like intergrades, juniper-oak woodlands, chaparral, and mixed coniferous forest. This vegetation exists under two rainy seasons/year with the result that there are two "greening up" periods/year. In addition, there are several species which retain a green appearance throughout the year. Thus there were three convenient phenological classes to which most of the plants which were encountered could be assigned: evergreens (EVGN); winter dormant (WIND); and winter-spring dormant (WISP). Discrimination criteria based on the phenological differences among these classes provided the means for stratifying the landscape into phenologically distinct areas.

Spectral radiance (ERTS multispectral scanner data) from three vegetation types was associated with seasonal changes in plant foliage. The vegetation types were: (1) mixed coniferous forest; (2) mesquite bosque; and (3) tobosagrass swale. The physiognomy of each was tree, shrub, and herbaceous, respectively. When all were in leaf (late summer), they had similar spectral radiance patterns. The evergreen coniferous forest had nearly the same pattern on the summer, winter, and spring sampling dates. The pattern varied substantially, however, for the shrub type after the mesquite leaves dropped, and for the tobosagrass when the leaves and culms were dried. Spectral radiance from the flat top of a copper mine trailings pile represented a surface which did not undergo temporal changes between the sampling dates. This provided a standard of "no change."

Several schemes for classifying radiance data were successfully used for discriminating the phenological patterns of the three vegetation types and the "no change" subject. The classification schemes utilized ERTS radiance data (MSS Bands 4, 5, 6, and 7), and values derived from that data: (1) MSS 5 ÷ MSS 7; (2) (MSS 7 − MSS 5) ÷ 9MSS 7 + MSS 5); and (3) date to date change factors for the derived values. Seventeen areas representing the four subjects were correctly identified with all schemes except the change factor scheme, which misidentified two areas.

Radiance in red wavelengths, which was strongly absorbed by green leaves, and radiance in the near infrared, which was strongly reflected by those leaves, were the best for discriminating among the phenological classes. Furthermore, data from two or more seasons permitted better identification results from data from one date.

Two test areas, each containing EVGN plus either WIND or WISP, were successfully stratified with the MSS 5 ÷ MSS 7 scheme. Vegetation stands representing the same plant community were classified into one phenological class when there was uniformity among the stands in their physiognomic appearances. This stratification provided a demonstration of a practical application of synoptic, multiseasonal, and multispectral remote sensing for characterizing a landscape. Furthermore, the stratification was accomplished with a small percentage (0.2%) of the available ERTS data points.