The Effect of Light Intensity on the Growth Characteristics of Alfalfa and Bromegrass

W. L. PRITCHETT AND L. B. NELSON

WITH the development of new stiff-strawed, and disease-resistant oat varieties of high yielding potentialities, it has become feasible to increase greatly oat yields in the corn belt through the application of commercial fertilizer, particularly nitrogen. Oats are no longer considered merely as a "nurse crop" for legume or legume-grass seedings, and farmers are seldom satisfied with 30-bushel oat yields when these can be increased to 50 bushels or more per acre. But with the increased potentiality of the oat crop, there has developed a new problem—one which may exert a deleterious influence upon the productivity of corn belt soils. This problem is that of obtaining a satisfactory stand of the legume or legume-grass seedings planted with oats. Good oat yields often mean poor seedings.

To illustrate the above, in experiments (9) conducted over a 3-year period in Iowa, applications of 40 pounds of nitrogen per acre in fertilizer have given an average response of 15.5 bushels of oats. However, in seven out of nine of these experiments, the yield of the hay crop following was materially reduced. Doubling the nitrogen application to 80 pounds per acre in every case resulted in severe decreases in hay yield, sometimes in almost complete seeding failures.

The factors responsible for this depression of hay yields in Iowa have been only partially established. Competitiveness of nutrient crops does not appear to be an important factor since phosphorus and potassium have been applied in adequate amounts in all of these experiments. Moisture usually has not been limiting. Decreases in yields still occur even in the most favorable seasons. Shading of the seedings appears to be the most likely factor involved. That this factor is important has been partially verified in the field through the marked improvement of seeding stands by permitting higher light intensities to reach the seedings through wide spacing of drill rows (12).

In order to establish more fully the effect of light intensity upon the growth, morphology, and vigor of legume and grass seedings, the work reported below with alfalfa and bromegrass was undertaken.

Review of Literature

Difficulties in establishing legume seedings have prompted much study on the competition for light and water between small grains and the forage seedlings. This work has been carried out by several investigators. In general, the competition for moisture and sunlight; consequently, the better position to survive normal summer drought those planted with broadcast oats. Dungan, et al. did Salmon (13), Montgomery (8), and Kiesselbach widened drill row spacings up to 14 to 16 inches, did not materially affect grain yields. However, factors do not agree as to whether the growth of oats by planting oats at a low rate and in wide drill rows agree that the practices that reduce competition and moisture favor the seeding. Thatcher, et al. repeated instances in fertilizer experiments of legumes being obtained on the unfertilized small grains and thin stands on fertilized plots that produced yields of the small grains. They concluded "the less the crop, the better the stand of forage," and that this would reduce the competition for moisture in dry seasons and light in wet seasons are to be recommended.

Klages (6) and others believe that plants grown in shade develop structures common to shade plants and are readily modified, becoming larger and thinner in habit. The environment of grass and leguminous plants growing in the shade of companion or "nurse" crops changes abruptly with the removal of these crops. The transition thus induced may be too great for the tender plants to withstand, especially if the removal of the nurse crop occurs during a period of sunlight.

Vegetative response of bromegrass to variations in light intensity was studied by Watkins (18). He found that a reduction in light intensity to 300-800 footcandles about a decrease in dry weight of all plant parts, grass growing under the lower light intensities, a decrease in the number of shoots, rhizomes, and dry weight of all plant parts, but increased the elongated internodes and height of the plant. The plants were more succulent but lacked the usual number of wide deep-green leaves of the plant in sunlight. Popp (11) reported similar results with clover under low light intensities.

Dibbern (1) found that less than half of the seedlings survived when grown a year under a shade of 25% light, and none survived a shade of 5% of full light. Klibansky et al. (7) reported that plants of bromegrass seedlings of the companion crop ranged from 4 to 17 times heavier from two to five times more tillers than similar plants of oats. Godel (3) and Pavlychenko and Harrington (10) found that shading by small grain was also effective in reducing weeds. Reporting on a similar problem, Stahl et al. noted that where soil moisture and essential soil nutrients light is the prime factor around which competition in companion crops.

Experimental Procedure

The experiment was conducted under greenhouse. Light intensity levels were obtained by enclosing the work or cage with muslin, the number of thicknesses was varied to produce the desired intensity. The light intensity levels were obtained by enclosing a wooden frame and muslin, the number of thicknesses of which was varied to produce the desired intensity. The cages were feet square and 4 feet high, and each covered eight 2-gallon pots.

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