YELLOW FOXTAIL LIFE CYCLE AND GERMINATION POTENTIAL IN AN ESTABLISHED ALFALFA HAY ENVIRONMENT

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In the past twenty-five years, yellow foxtail (pigeongrass, bristlegrass) (Setaria lutescens) (Weigel Hubb) has become a serious weed problem in hay alfalfa (Medicago sativa). Yellow foxtail-infested alfalfa fields have been documented in twenty-five counties throughout California (1). Field and laboratory studies (2, 3, 6) have shown this short-day summer annual plant to be very adaptable to California hay alfalfa environments, but actual documentation of its life cycle in established alfalfa has not been previously recorded. Therefore, a field study was initiated to determine (a) yellow foxtail life cycle in an established alfalfa field, and (b) yellow foxtail germination potential throughout the growing season.

MATERIALS AND METHODS

Experiment I: Field Life Cycle Study. The test site was a second-year alfalfa field located on the Eli Lilly and Company research station in Fresno, CA. The yellow foxtail seed* for the life cycle study was sown on December 12, 1983 at 1.1 gram per square foot on four 100-square-foot plots. Two-square-foot subplots were marked off in each replication from which dates of initial yellow foxtail germination, tillering, time to flower, and seed maturity were recorded. Also, yellow foxtail population, plant tiller production and seed head production were recorded. Immediately following harvest of mature seed, laboratory percentage germination potential studies were initiated at monthly intervals at 72°F for nine day's duration. Soil temperatures were taken weekly at the surface and at a depth of one inch. Alfalfa in the experimental area was mowed and irrigated as required.

Experiment II. Germination Potential and Life Cycle in Relation to Month Emerged. Nine 100-square-foot plots were selected for the germination potential study. Two-square-foot subplots were overseeded with five hundred seeds per square foot. At monthly intervals, yellow foxtail seedlings were removed from one subplot and observed for subsequent germination. Plant growth stages were recorded for each month emerged. Mature seed were harvested from plants and stored out-of-doors for sequence germination studies. Soil surface temperatures were recorded with a self-recording thermograph.

1983 Seed Source. A 1983 yellow foxtail-infested field was located April 15, 1984 at a site 500 yards west of the original trials. The seedlings at this site were in the 2- to 3-leaf stage. Trials were established to duplicate Experiments I and II. Stand counts and other data collected from this site were added to the data base.

RESULTS AND DISCUSSION

Experiment I: Field Life Cycle Study. Yellow foxtail emergence started on February 28, which supports observations by Colbert, et al (1). Subsequent emergence in the experimental area increased until a maximum plant population was reached during the month of May (Figure 1). The high soil temperatures during the months of June, July and August (85 to 100°F) may have been one factor which caused the decreased yellow foxtail establishment. Laboratory germination studies have shown temperatures above 90°F reduce yellow foxtail germination potential (3). The loss of seed viability and/or development of secondary dormancy are possible explanations for decreased establishment as cumulative emergence from February 28 through June 1 resulted in only 9.2 percent emergence. Laboratory germination tests showed that the 1982 seed lot had decreased from 54 to 1 percent by August 1984, 22 months after harvest.

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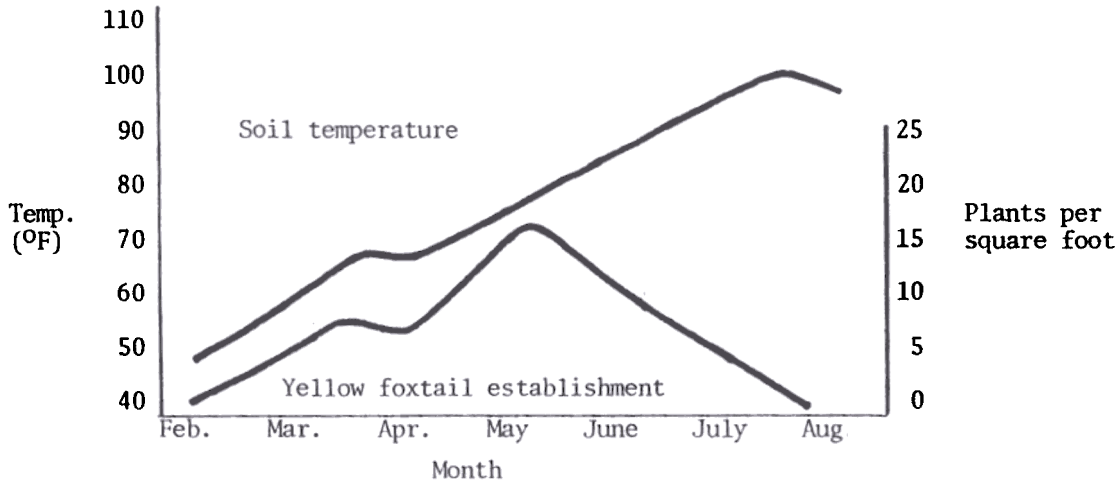
*Seed were harvested from a Tulare County alfalfa field in November 1982. Germination potential for the seed was determined to be 54 percent at trial initiation.

Figure 1. The relationship between soil temperature and yellow foxtail emergence and establishment.



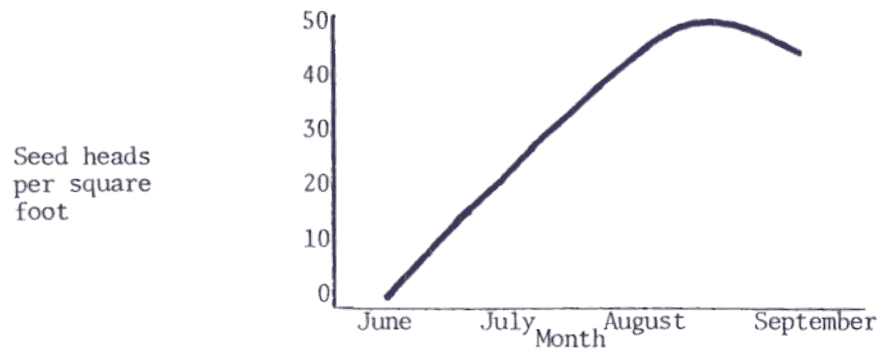
Yellow foxtail tiller growth began ten weeks after emergence (May 10 ± 7 days). As the number of plant tillers increased, the prostrate growth habit became apparent. Schoner, et al (6) have suggested that the prostrate growth habits of the California yellow foxtail is a biotype characteristic which aids its survival in established alfalfa. In this study, plant density had an effect on the number of tillers produced per plant; that is, as plant populations increased, the number of tillers per plant decreased (Table 1). This response was also observed by Peters and Yokum (4) in their studies.

Table 1. Yellow foxtail plant density and its effect on individual plant tiller and seed head production.

Density (plants per square foot)	Tillers per plant	Seed heads per plant
8.0	6.6	5.1
37.5	5.6	4.2
62.5	4.8	1.4
95.0	3.0	0.7
120.0	2.1	1.2
Observation date:	(5/24)	(8/15)

Plant tiller growth habits were also observed to affect seed head (panicle) development as shown in Table 1. Yellow foxtail flowering began June 19 (± 5 days), fourteen weeks following emergence. Seed head production increased until late August (Figure 2). Seed maturity (shatter stage) was first observed on July 23, four weeks following the initiation of flowering.

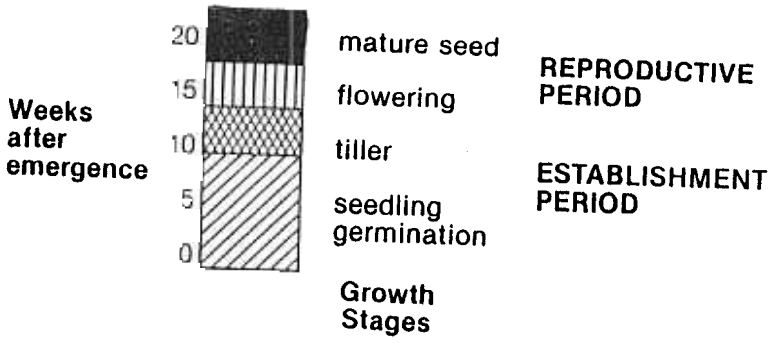
Figure 2. Yellow foxtail seedhead production under field conditions.



*Alfalfa field was plowed out; therefore, no later observations could be taken.

A summary of the life cycle for yellow foxtail established in February is shown in Figure 3.

Figure 3. Yellow foxtail growth stages for February-emerged plants



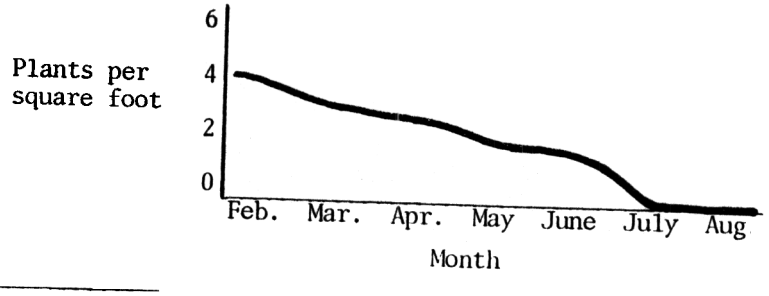
Norris and Schoner (3) reported less than 5 percent germination from yellow foxtail seed tested immediately following collection. Their studies suggested that an after-ripening period of four months is required. In this study, seed collected from the first mature panicles in July and tested immediately resulted in no germination under laboratory conditions. Preliminary post-harvest germination results are shown in Table 2.

Table 2. Percentage yellow foxtail seed germination following harvest.

Weeks after harvest	Percentage germination
0	0
4	0
8	11
12	42
16	-*

Experiment II. Germination Potential and Life Cycle in Relation to Month Emerged. Yellow foxtail germination potential during the growing season was shown to be greatest from February to early April for the 1982 seed lot (Figure 4). Soil temperatures ranged from 47 to 52°F in February and from 58 to 68°F in late March and early April. In July and August no germination was recorded. The late winter and spring low plant emergence counts and lack of germination in the mid-summer months may be due to low seed viability, secondary dormancy, and/or high soil temperatures as suggested earlier.

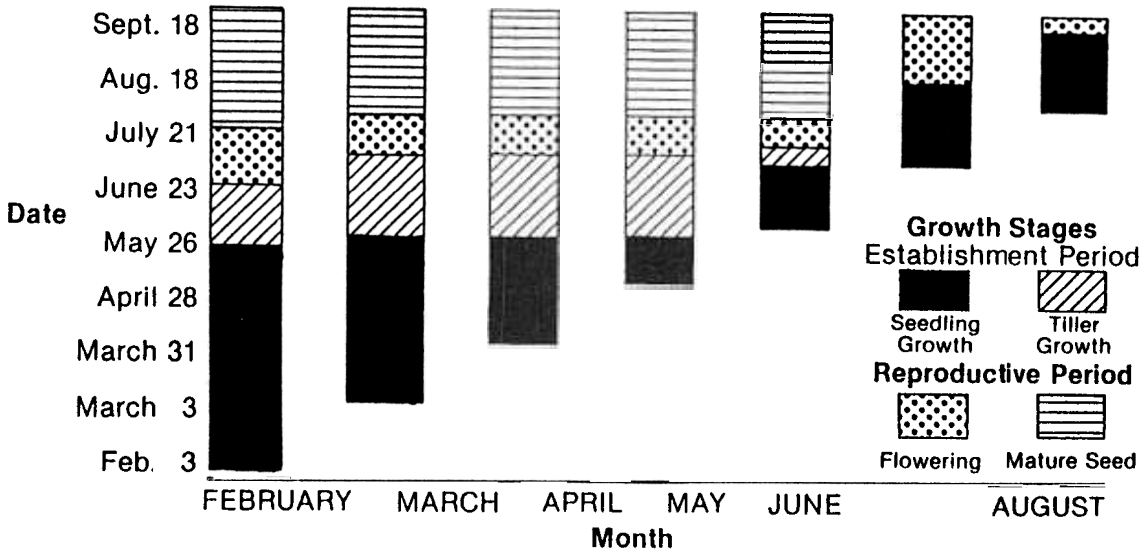
Figure 4. Yellow foxtail field emergence by month from the 1982 seed source.



*Sixteen week germination observations are currently in progress.

Yellow foxtail growth stages showed only slight variations in the establishment period for plants emerging in February versus plants established in May (Figure 5). The only significant difference was the length of seedling growth stages. Plants which emerged in March and April reached the tillering growth stage within one week of the plants established in February. Seed germinating in May reached the tiller stage in less time than plants which emerged in March and April.

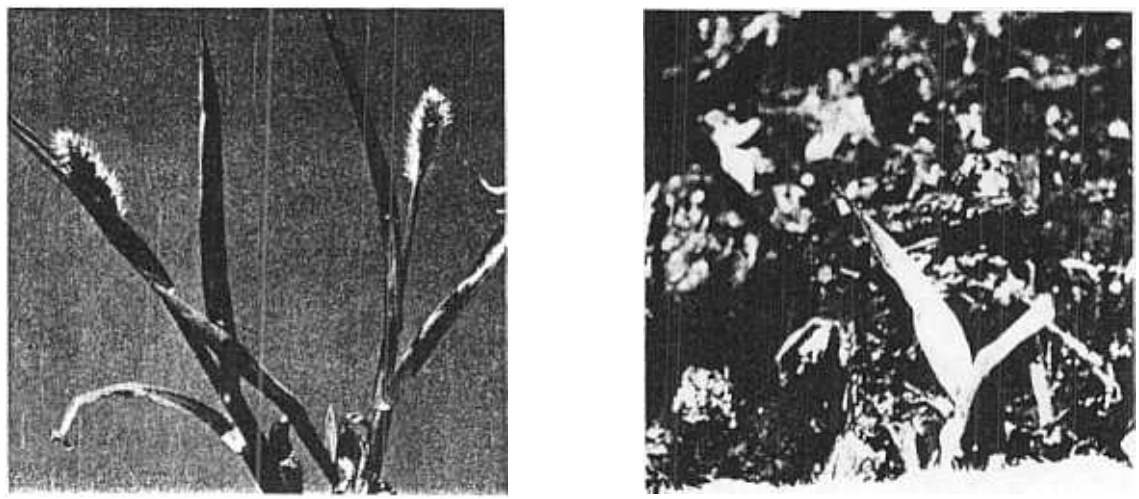
Figure 5 Yellow foxtai ife cycle in relation to month emerged



Yellow foxtail flowering (seed head development) was initiated on June 29 for seedlings established in the month of February. Plants emerging in March, April and May reached the reproductive stage by July 12. Mature seed were first observed on July 14 for the February germination and on July 23 for March-, April-, and May-germinating plants. Life cycle length for plants emerged in June or later was much reduced as shown in Figure 5. Seedlings established in the month of June reached the tiller stage by June 29, flowering on July 12, thus demonstrating the short-day growth habit of yellow foxtail. Plants which emerged in July exhibited a very short establishment period resulting in plants only four to six inches in height, rarely producing tillers, and reaching the reproductive period within six to seven weeks. Seed germinating in August did not produce any tillers and reached flowering at the 3- to 4-leaf stage (2 to 3 inches) on September 18 (Figure 6). Research reported by others (4, 5) substantiates the observed short-day flowering response from July- and August-emerged yellow foxtail plants.

igure 6 Late-season emergence of yellow foxtail: (a) July-emerged plant with seed heads, and (b) August-emerged seedling. Photos were taken August 10, 1984.

(a) (b)



Senescence was observed for individual plant tillers within 16 days after shatter stage, but death of the whole plant did not occur before the trial was terminated--even for February-emerged plants.

SUMMARY

The annual life cycle of yellow foxtail in an established alfalfa field demonstrated the potential for germination to commence in February and continue through August. The potential for plant emergence was shown to be greatest during the months of February, March and April when soil temperatures ranged from 47 to 68°F. Plant populations increased until mid-May when higher soil temperatures resulted in decreased plant establishment. Plant populations were also shown to affect tiller and seed head development, for at high plant density, tiller and seed head production per individual plant were less. Post-harvest germination observations demonstrated that yellow foxtail seed may have limited germination potential within two months following harvest.

The success of yellow foxtail infestations in established alfalfa can be attributed to life cycle adaptations during the growing season. Length of growth stages depended on month of plant emergence; early-season plant emergence had longer establishment periods than those which emerged later in the season. Plants which emerged in July and August had shorter establishment periods and flowered within six to seven weeks from emergence.

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