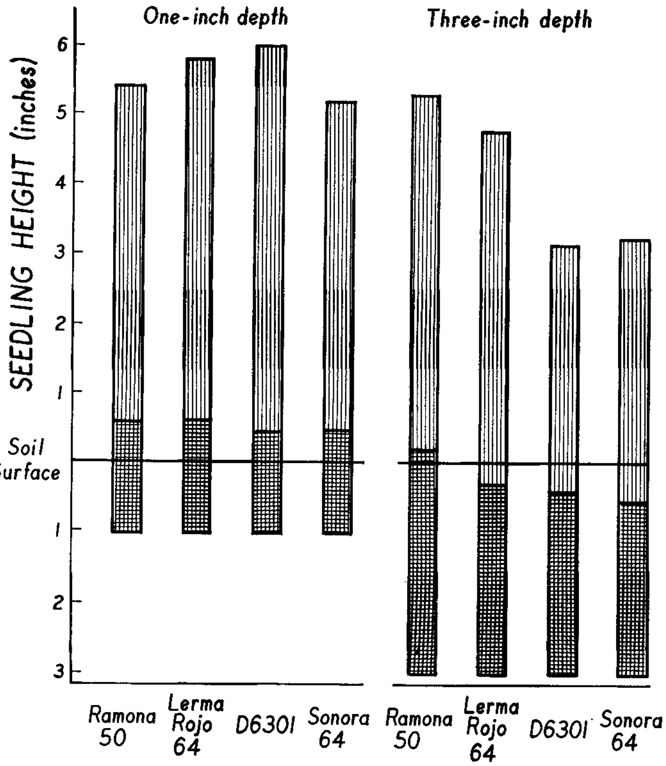


Coleoptile length (in darkened bars), and seedling height after eight days for four wheat varieties grown at two planting depths in the greenhouse.

PLANTING DEPTH *critical for short-statured wheat varieties*

J. T. FEATHER · C. O. QUALSET
H. E. VOGT

THE PROPER PLANTING DEPTH of wheat seed is particularly important for good seedling emergence and stand establishment when short-statured varieties are grown. Research in progress at U.C., Davis indicates that the recommended planting depth of 1½ to 2 inches should be followed closely when currently popular varieties such as Pitic 62, Lerma Rojo 64, Sonora 64, and other short-statured wheats are used. The length of the coleoptile (the protective sheath which surrounds the first foliage leaves prior to emergence) is the reason, since it often is only 50 to 75 per cent as long as that found in Ramona 50 and other taller varieties. Certain wheat strains—if planted deeper than 2 inches—may never develop a coleoptile long enough for emergence.

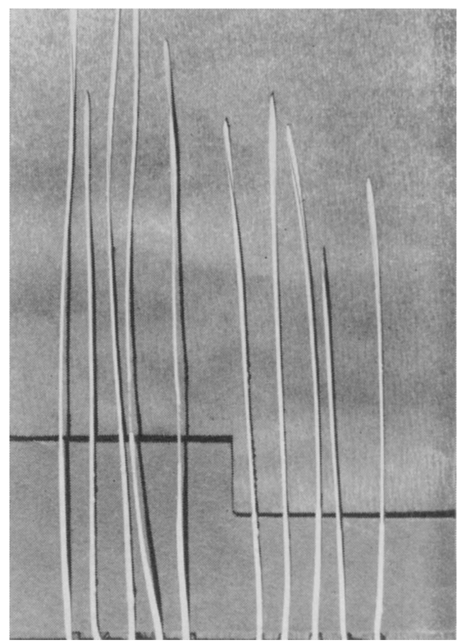
When the wheat seed germinates, the plumule or shoot enclosed in the coleoptile grows upward from the seed. The plumule consists of small foliage leaves which form a cone within the coleoptile. When the coleoptile is exposed to light at the soil surface after emerging from a normal planting depth it ceases to grow. The first leaf then emerges through the apex of the coleoptile.

Since wheat varieties differ in coleoptile length, a study was initiated to determine the relative emergence at various planting depths under greenhouse conditions, and to classify them through laboratory germination techniques.

A greenhouse experiment to determine coleoptile length and rate of emergence from 1-, 3-, and 5-inch planting depths for five wheat varieties was conducted in January, 1968. Twenty uniformly sized seeds per replication of each variety were planted in pots in a completely randomized design. The substrate consisted of equal amounts of UC mix and soil. Counts of emerged seedlings were taken daily beginning four days after planting and germination was considered complete after 11 days. Then all seedlings were removed carefully from the pots and the average coleoptile length was determined from 10 plants. A similar experiment was planted and grown outside.

Although all varieties emerged well at the 1-inch depth, all were affected by the 3-inch depth, especially Sonora 64 and D6301 (table 1). No emergence was observed in the test at the 5-inch depth. The length of coleoptile usually increased with planting depth. Rate of emergence and total germination of Ramona 50, Lerma Rojo 64, and Sonora 64 are compared in graph 1. These latter varieties—with coleoptiles less than 70 per cent as long as Ramona 50 under laboratory conditions, emerged at a slower rate than Ramona 50 at the 3-inch depth.

In another study, four varieties were planted at two depths. Differences in total coleoptile length and amount of growth above the soil surface are shown in graph above, along with seedling height after eight days. At the 3-inch depth only the coleoptile of Ramona 50 elongated sufficiently to reach the soil surface.



Differential coleoptile and seedling length of two wheat varieties after germination and growth in the dark for 12 days. The coleoptile growth of Ramona 50 (left) reached 2.7 inches whereas Sonora 64, a short-statured variety, was 1.7 inches in length.

Relative coleoptile length of seven wheat varieties was determined in a laboratory experiment. The Cobb-Jones slanted-substrate technique was used. Seeds were placed on moist paper over an

TABLE 1. COLEOPTILE LENGTH AND SEEDLING EMERGENCE OF FIVE WHEAT VARIETIES PLANTED AT THREE DEPTHS IN SOIL IN POTS OUTSIDE AND INSIDE OF THE GREENHOUSE IN JANUARY

Variety	1-inch depth		3-inch depth		5-inch depth	
	inside	outside	inside	outside	inside	outside
			Coleoptile length, inches			
Ramona 50	1.69	1.46	2.60	2.13	2.63	2.13
Lerma Rojo*	1.42	1.46	2.64	1.81	2.52	1.77
Lerma Rojo 64	1.69	1.54	2.29	1.85	2.52	1.65
Sonora 64	1.58	1.42	2.21	1.93	2.44	2.05
D6301†	1.58	1.42	2.25	1.65	2.36	1.69
			Per cent emergence			
Ramona 50	94	93	51	3	0	0
Lerma Rojo	90	85	45	5	0	0
Lerma Rojo 64	97	95	49	0	0	0
Sonora 64	97	95	29	3	0	0
D6301	97	88	30	0	0	0

* Seed grown 1965; balance from 1967 stock.
† D6301 is a selection from the cross Mayo 54 x Norin 10-Brevor.

TABLE 2. CLASSIFICATION OF TALL (ABOVE DOTTED LINE) AND SHORT-STATURED (BELOW) WHEAT VARIETIES FOR COLEOPTILE LENGTH UNDER DARKENED LABORATORY CONDITIONS AT 74°F AND MATURE PLANT HEIGHT IN FIELD EXPERIMENTS

Variety	Coleoptile length in laboratory		Mature plant height
	Inches	% of Ramona 50*	inches
Lerma Rojo	3.00	107	46.4
Yaqui 54	3.00	107	41.4
Nainari 60	2.90	104	39.3
Ramona 50	2.80	100	41.4
White Federation 54.	2.70	96	41.8
Tobari 66	2.20	79	33.5
Pitic 62	2.10	75	35.6
Maricopa	2.00	71	36.4
Nadadores 63	1.92	69	37.7
Red River 68	1.86	66	38.5
Siete Cerros 66	1.83	65	35.2
D5301	1.81	65	27.7
Super X	1.80	64	34.8
Jaral 66	1.80	64	31.9
Mexipak 65	1.78	64	35.6
Bajio 66	1.78	64	30.6
Sonora 64	1.78	64	31.9
CIANO 67	1.77	63	33.5
Lerma Rojo 64	1.76	63	38.9
Norteño 67	1.74	62	36.4
Roqui 66	1.72	61	32.3
Noroeste 66	1.71	61	31.5
INIA 66	1.69	60	33.1
L†	1.10	39	19.1

* Figures followed by the same line are not significantly different at the 5% level.
† L is a selection from the cross Lee x Norin 10-Brevor.

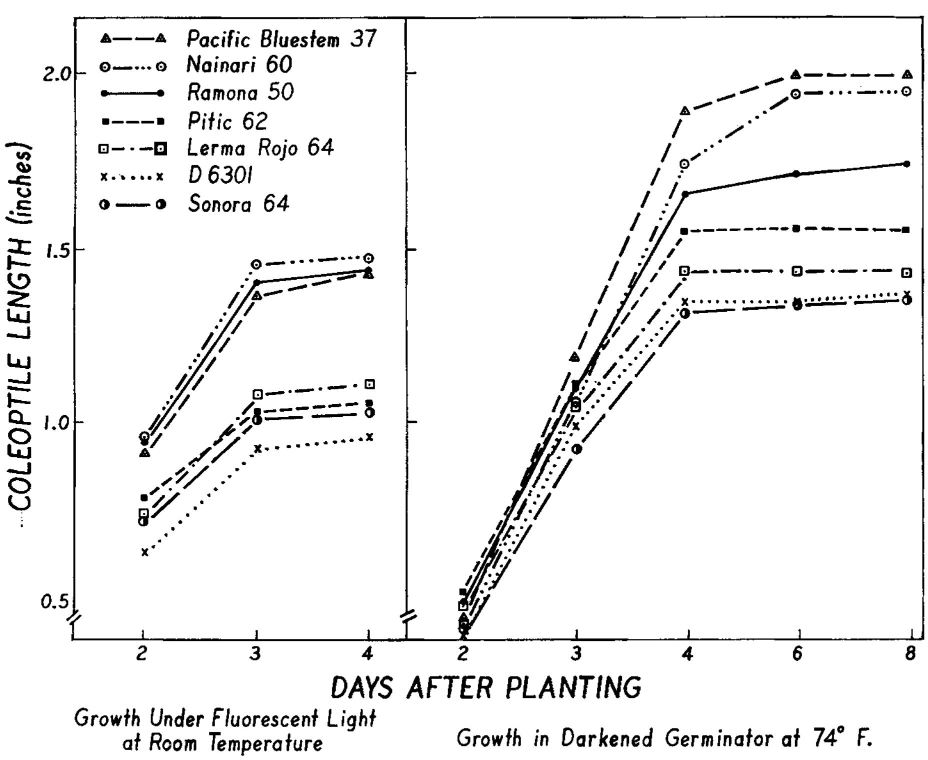
acrylic plastic sheet and held in place by a single ply of "Kleenex" dampened with a water mist. One sheet was used for each variety and these were placed at a 67° angle in a supporting rack which was lowered into a tray with water reservoir.

Seed was germinated for four days under fluorescent lights at room temperature and for eight days at 74° F in a darkened germinator. Fifteen seeds were used in each of three replications for each condition. Two groups differing significantly in coleoptile length (graph below) were found under the lights. The coleoptile length was nearly 50 per cent longer in the darkened germinator than the length obtained from the experiment with fluorescent light. The relative coleoptile length of Ramona 50 and Sonora 64 is evident in the photograph. Varieties with short coleoptiles when grown in light were also short when grown in the dark.

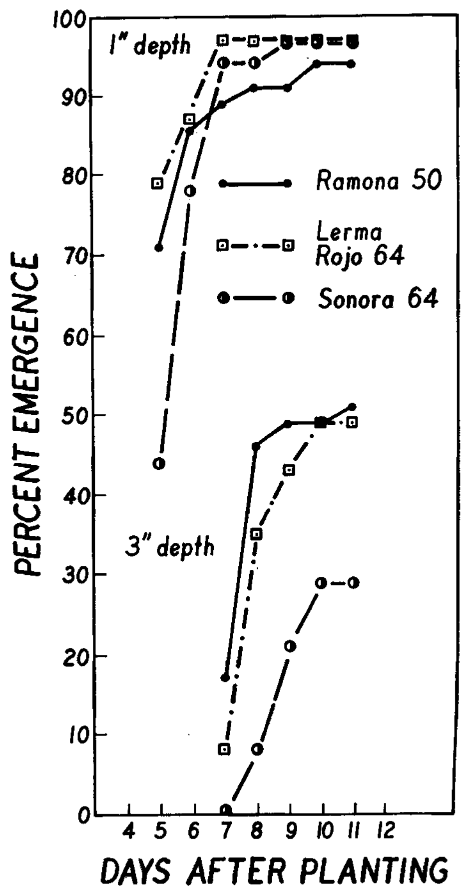
In a second experiment, 24 varieties were evaluated and compared with mature plant height from field experiments in table 2. Nainari 60, Lerma Rojo and Yaqui 54 exceeded Ramona 50 in length of coleoptile. The coleoptile of short-statured varieties (those shorter than White Federation 54 in table 2) were less than 80 per cent as long as Ramona 50. Lerma Rojo and Lerma Rojo 64 are very similar agronomically except for the shorter coleoptile and mature plant height. A highly significant correlation between coleoptile length and plant height for these 24 varieties was observed ($r = .805$).

Until short-statured wheat varieties are developed that possess long coleoptiles, these data emphasize the importance of controlling planting depth. Many of these wheats tend to emerge slower than tall varieties, such as Ramona 50, and may often lack the necessary seedling vigor to survive if planted too deep, since the coleoptile may cease to grow while still beneath the soil surface. If this occurs, the first leaf probably will emerge through the tip of the coleoptile, and—lacking the protective shield to carry it to

Rate of coleoptile growth of seven wheat varieties in two environments.



Rate of emergence and total emergence of three wheat varieties planted at one-inch and three-inch depths in greenhouse conditions.



the light—will succumb to adverse conditions since foliage leaves have little "push-power" themselves. The depth of seeding, therefore, should not exceed the potential coleoptile length or 1½ to 2 inches.

Research is being continued toward correlating coleoptile length with rate of field emergence. How soil temperatures as well as other factors at planting time and during emergence affect stand establishment in California's wheatlands will be investigated. Laboratory germination techniques will be used for screening various generations of breeding material prior to field plantings and eliminating those selections with inherently poor coleoptile length and/or seedling vigor.

It is hoped that continuous plant breeding efforts combined with laboratory, greenhouse and field evaluations, will result in high yielding, short-statured wheat varieties for California growers that will have an inherent capacity for strong, rapid, early growth and improved potential for satisfactory stand establishment.

J. T. Feather is Assistant Specialist in Agronomy, C. O. Qualset is Assistant Professor of Agronomy, and H. E. Vogt is Laboratory Technician in Agronomy.
J. D. Prato assisted by providing much of the plant height data reported here.

New Sugar Beet Varieties Reduce Losses from Virus Yellows

J. S. MCFARLANE · I. O. SKOYEN

Two hybrid sugar beet varieties with moderate resistance to virus yellows have been released to California growers. The varieties designated US H9A and US H9B are both monogerm and were developed at the U. S. Agricultural Research Station, Salinas. The new varieties perform best in those areas of the State in which damage from yellows is severe, but they also perform well under yellows-free conditions. In 17 tests under conditions of moderate to severe yellows, US H9A produced 22 per cent more sugar than did the widely grown US H7 variety. In 11 tests, US H9B produced a 27 per cent higher yield of sugar than did US H7. Both varieties averaged about 0.3 of a percentage point higher in sucrose than did US H7. Seed has been produced by the sugar companies and is now available for wide scale planting.

SUGAR BEET PRODUCTION in California is generally hampered by the damaging effect of virus yellows. Earlier research by plant pathologists had shown that there are two separate yellowing diseases involved: beet yellows, and beet western yellows. They are caused by two distinct viruses, both of which are spread by aphids. The green peach aphid, *Myzus persicae* (Sulzer), is the principal vector. The two diseases produce similar symptoms and are difficult to distinguish in the field. First symptoms consist of a slight yellowing of the plant. Vein clearing or etching of young leaves may also be an early symptom of beet yellows, but not of beet western yellows. Older leaves yellow, develop necrotic spots, and die prematurely. Symptoms are usually more severe with beet yellows.

Western yellows

Beet western yellows has a wider distribution than beet yellows and occurs in all beet-growing districts of California. High percentages of infection occur each year in many areas. Beet yellows is widespread in the coastal valleys. Infection often occurs in the Imperial Valley, but frequently takes place after the beets have made much of their growth. In the Central Valley, beet yellows is often a serious problem in districts that grow beets as a continuous crop.

Beet yellows is the more damaging of the two diseases and may cause crop losses of 20 to 40 per cent. Losses from beet western yellows range from about 10 to 20 per cent. When both viruses are present, the losses are additive. Losses are greatest when infection occurs to young plants.

Breeding program

A breeding program to develop varieties resistant to yellows has been underway at the U.S. Agricultural Research Station, Salinas, since 1955. A survey of more than 350 different varieties and breeding lines failed to uncover a source of high resistance. Improvements in resistance have been made by selecting from existing varieties and breeding lines after field inoculation with a combination of beet and western yellows viruses. Greatest progress has been made with selections from US 75, an open-pollinated, multigerm variety that was widely used in California during the 1950s. After five successive generations of selection, the 413 line (which shows about one-half as much damage from yellows as US 75) was developed. The selection is multigerm and does not yield enough to be used as a commercial variety. Extensive testing has shown 413 to perform well when used as the pollen parent in hybrids.

US H9A and US H9B

Two monogerm, hybrid varieties utilizing the 413 selection as the pollen parent have been released for use by sugar beet growers. The varieties, designated US H9A and US H9B, were developed at the U. S. Agricultural Research Station in cooperation with the Beet Sugar Development Foundation, the California Beet Growers Association, and the University of California. They have been tested during the past three years by the U. S. Department of Agriculture and the California sugar companies.

US H9A has the parentage (562HO x 569) x 413. The parentage of US H9B is similar except for the substitution of 546 for the 569 inbred. The seed-bearing parent, 562HO x 569, is an F_1 hybrid