Cereal Breeding

This is the fifteenth article in a series of brief progress reports on the application of the science of genetics to commercial agriculture.

investigations show awned wheat exceeds awnless in yield, kernel weight and test weight per bushel

Coit A. Suneson

The grain of the awned varieties of Baart wheat and of Onas wheat weighs about one pound per bushel more than the grain of the awnless varieties.

Regional tests during the years 1943 to 1945, and tests at Davis from 1943 to 1949 showed that yield per acre and individual kernel weight in either Baart or Onas averaged 5% to 8% higher when the variety had awns—the slender bristles which form the beard.

Awnless wheats are generally preferred by California growers. The choice of awnless wheat is largely related to personal convenience in handling, or for animal palatability.

The two series of tests illustrated two significant applications of the science of genetics to commercial agriculture.

The awnless or the awned condition in wheat may be interchanged by the transfer of only two genes—those factors which determine the heritability of characters; such as disease resistance, conformation, color.

The gene transfer may be accomplished by several methods but in these studies two methods of hybrid population management were used.

An awned variety of Baart wheat and an awnless variety of Onas wheat were selected for use in the experiments. Baart is more widely grown than Onas although Onas has a higher yield under certain conditions.

An experimental hybrid wheat was obtained by crossbreeding the Baart and the Onas varieties.

The F_1—first generation—hybrid was tip-awned. The second generation—F_2—produced numerous awned segregates—specimens in which awn genes were present so the plants bred true to the awned characteristic. At the same time and in the same generation, there were many specimen segregates which bred true for the awnless characteristic.

All the true breeding segregates of like type were mixed together—awned segregates in one mixture and awnless types in a second mixture. The mixtures were made without regard for qualities other than the contracted true breeding awn types.

No two plants in either mixture were exactly alike for all characters, but it was assumed that good and bad qualities from both parents were distributed at random in the two populations.

The two mixtures were tested for yield and compared with each other and the differences in performance observed at

Continued on page 7

BRUSH

Continued from page 3

ing of the foliage was more rapid when the salt form of 2,4-D was used.

New growth in the form of sprouts was observed on the lower portions of many stems of chamise and ceanothus several months after spraying. These sprouts had extremely short internodes and an erratic growth form. After a period of approximately six weeks numerous sprouts dried and fell from the stems. Some plants appeared dead within six months after spraying.

In many cases subsequent examination, following the next growing season, revealed vigorous sprouting on the stems and from the basal portions of the plants.

Miscellaneous tests involving chemical sprays have been made in an endeavor to control sprouts of liveoak, scrub oak, and blue oak. Generally, results have been discouraging where various forms of 2,4-D have been used.

A spray mixture of diesel oil and a commercial brush killer has been reported to reduce oak stump sprouting by as much as 75% in a single application; but much remains to be learned as to how best to chemically control oak sprouts.

Observations made of various tests over the state point to the probability that poison oak—*Rhus diversiloba*—can be controlled by applications in the spring—during period of vigorous growth—of 2,4,5-T and brush killers of formulations containing both 2,4-D and 2,4,5-T. Ammate also has been used effectively on poison oak.

Poison oak is frequently heavily browsed in the summer. Spraying of the regrowth in late summer may prove particularly effective on browsed poison oak.

Seedlings of Yerba Santa—*Eriodictyon californicum*—seem susceptible to the amine salt and isopropyl ester of 2,4-D at the rate of two pounds of active ingredient per acre, according to reports. In Ventura County these materials were tried on Yerba Santa and mature plants seemed moderately susceptible.

Solutions of 2,4,5-T and commercial brush killers have given promising results in the control of California blackberry—*Rubus vitifolius* C. & S. Best results have been obtained where sprouts were spring sprayed following burns or mowing.

Extensive California experiments have been conducted by many investigators on wild current—*Ribes* spp.—control with chemicals.

Chief objective of one series of trials was to test new formulations of growth-regulating substances on *Ribes* species not readily killed by 2,4-D.

The herbicide was applied by: spraying leaves and stems of intact plants; decapitating plants near the ground line and applying phenoxy concentrate in oil or water to the freshly cut surface of the root crown, and; by applying phenoxy concentrate in diesel oil or kerosene to the intact basal stems.

Most *Ribes* species were killed effectively by all methods of treatment. 2,4,5-T proved to be significantly better than 2,4-D as a general purpose herbicide, being much less selective than 2,4-D.

Erratic results have been obtained by various workers in tests with 2,4-D and 2,4,5-T and combinations thereof on the following California species: juniper, sumac, southern California black walnut, coffee berry, lemonade berry, wild licorice, and elderberry. All appear to have some degree of susceptibility.

As yet chemical control has not found its exact place in the over-all brush control program. Much experimental work and field testing remains to be done.

P. S. Pattengale is Farm Advisor, San Benito County.

M. D. Miller, Farm Advisor, Glenn County, was Extension Specialist in Agronomy, Davis, at the time the studies reported here were conducted with the co-operation of J. J. McNamara, Reuben Albaugh, R. A. Brendler, and F. W. Dorman of the University of California Agricultural Extension Service.

That portion of the foregoing article concerned with Ribes *spp. is based upon work reported by H. R. Offord and V. D. Moses of the United States Department of Agriculture.*

Northern California Walnuts

environmental resistance a factor in the control of codling moth populations shown in tests at Linden

A. E. Michelbacher, W. W. Middlekauff and Donald Davis

Control of the codling moth on susceptible varieties of walnuts usually requires spray applications each year.

Because sprays are necessary some growers hold the opinion that natural environmental factors are not important in regulating the codling moth population.

Codling moth population shows considerable fluctuation over a period of years, and evidence obtained at Linden, indicates that the environment exerts an important regulating influence upon the pest. Under an effective spray control program, it is usually difficult to detect the effect of these natural controlling factors, because of the suppressed population.

When the codling moth investigation was started at Linden in 1942, the infestation was of serious proportions. The number of infested nuts in the harvested crop from check trees exceeded 25%. With subsequent years, the control program was greatly improved and the seriousness of the infestations as measured by the amount of infested nuts in the check trees declined so that by 1945 it was 6.8% and in 1946 it was 7.0%.

These data indicate that the reduction in the seriousness of the problem was due to the effectiveness of the codling moth spray control program. However, this probably was not the case because—although the same program was continued—the infestation in the harvested crop in the check trees reached 44% in 1948 and was 22% in 1949.

These increases in infestations could not be attributed to the insect becoming resistant to standard lead arsenate as—in spite of the heavy infestation—excellent control was obtained where sprays were properly timed and carefully applied. Further, there was a general increase in the infestation even in orchards or areas where no sprays were applied. There can be but little question that climatic and biological factors were important in influencing the size of the codling moth population.

It appears that when these factors afford a high environmental resistance, the codling moth population is reduced and spray control programs benefit. When these factors favor the codling moth, spray programs are put to a severe test and satisfactory control can be obtained only where they are properly timed and thoroughly applied.

The action of natural controlling fac-

Continued on page 10

Parasitism of Second Brood Codling Moth Eggs by *Trichogramma embryophagum* Hartig in the Experimental Orchard at Linden, California, 1949

Date	Total number of eggs	Condition of Eggs											
		With dead larvae		Hatched		Not hatched		Parasitized					
								Not emerged		Emerged		Total	
		number	per cent	number	per cent	number	per cent	number	per cent	number	per cent	number	per cent
July 26	210	.	..	57	27.1	39	18.6	51	24.3	63	30.0	114	54.3
Aug. 1	208	9	4.3	55	26.4	21	10.1	49	23.6	74	35.6	123	59.1
Aug. 3	214	9	4.2	75	35.0	5	2.3	51	23.8	74	34.6	125	58.4
Aug. 11*	144	5	3.5	109	75.7	1	0.7	19	13.2	10	6.9	29	20.1
Aug. 25*	203	4	2.0	117	57.6	0	0.0	16	7.9	66	32.5	82	40.4

* Survey conducted in a portion of the orchard one half mile from the previous survey area.

CEREAL

Continued from page 5

Davis were essentially the same as those observed at other experiment stations in the western region.

The awned plants exceeded awnless plants in yield, kernel weight, and test weight per bushel.

Two new varietal types were also produced by backcrossing the hybrid strain obtained by crossing Baart with Onas.

This method of breeding permits recovery of practically all of the characters from one of the parents. One of the new varieties, resulting from eleven successive backcrosses to Baart, is like Baart in every characteristic except that it lacks awns. The other variety which was the result of 10 generations of backcrossing to Onas, is essentially an awned Onas.

Thus, with awned and awnless stocks of Baart and Onas, it was possible to determine the effect of awns in two different varieties.

Awnless Baart was of value only for experimentation. If grown commercially, it would certainly yield less and weigh less per bushel than the awned Baart now grown. It will not be released.

The Onas wheat and the bunt resistant Onas 41, which are grown in California are awnless. Though they already yield more than Baart, under some conditions, their low weight per bushel is a universal handicap in marketing. This difficulty can largely be overcome by use of the new awned form of Onas.

Wheat breeders at the California Experiment Station move through a succession of gains in production efficiency or security. These gains are exemplified by the new awned and bunt resistant Onas 49, obtained from the union of Awned Onas and Onas 41.

Onas 49 was tested in more than 10 county nurseries in 1950 and foundation seed will be available for 1951.

Growers in rust-hazard areas should recognize that Onas 49 does not have rust resistance. In 1953 Onas 49 will have been combined with an Onas which has a new type of rust resistance—from Kenya. The variety Hope has provided the resistance for all previous breeding. Kenya and Hope have different genes and protect against different races of rust. The new stock should replace all previous releases of Onas and even some other varieties.

This combination of characters illustrates how one improvement after another is built into a basic variety chassis to make the variety better and better.

They show that plant breeders, using genetic laws as tools, can provide basic information for other fields of science. Furthermore the mysticism which has long shrouded plant breeding is being unmasked by use of genetic principles in breeding. These permit both prediction and reproduction of results.

Progress in the future will probably be slowed more by time requirements and capacity than from lack of know how.

Coit A. Suneson is Associate in Agronomy in the University of California College of Agriculture Experiment Station, Davis and Agronomist, United States Department of Agriculture.