An Analysis of Floret Fertility in *Agropyron repens*

J. H. Lefforge, Purdue University

In the summer of 1938 quackgrass, *Agropyron repens* (L.) *Beauv.*, spikes were collected for laboratory studies on noxious weeds. When ready for use in the fall it was observed that only a few of the florets were fertile. Since the amount of grain actually produced by quackgrass is a factor in its spread and control, an analysis of floret fertility was made.

Taxonomically, quackgrass belongs to the Hordeae tribe of the Gramineae. Phylogenetically the genus *Agropyron* is rather closely related to wheat and certain species of *Agropyron* have been known to hybridize with *Triticum*. Its vegetative and flowering periods are essentially the same as wheat.

As reported in the literature, quackgrass varies rather widely in its seed setting pattern. Such variation has been attributed largely to environmental factors but may also be due to genetic variability. In general, it appears that more seed has been produced on soils of average fertility than on the more fertile soils, and in drier seasons than in those of high rainfall.

Quackgrass is a perennial cool season plant which makes its best growth in cool moist climates and on soil of average to high fertility. It survives the rigors of winter better than the long, hot, dry summers.

Review of Literature

According to Quackenbush and Carter (9), quackgrass is a primary noxious weed in Indiana and one of the most serious weeds of that group. Deam (3) reports this grass chiefly in the northern two-thirds of the state yet it probably could be found in every county. While quackgrass was introduced from Europe, Eliot is credited by Kephart (5) with the first authentic report of the weed in this country in 1751. By 1850 it was well distributed east of the Allegheny mountains. It followed the emigrants westward and by 1890 had reached Minnesota. Quackgrass is now known to occur in all states north of the 35th parallel (Hitchcock, 4).

The geographic distribution of this weed has been further reported by Kephart (5) who states that it has been found as far north as the limits of cultivation, that it never winterkills and seldom becomes troublesome as a weed south of the Ohio River. He further states that quackgrass is a relatively poor seeder. Loose cultivated soil promotes good vegetative growth but fewer seeds. Oswald and Boss (7) state that

each spikelet when mature contains from three to seven seeds. Arny (2) states that the spikes bear many seeds while Kephart (5) reports an average of twenty-five viable seeds per spike. Kephart further states that yields of quackgrass seed of eighteen bushels per acre have been obtained in Michigan.

Materials and Methods

Some eight hundred spikes of quackgrass were collected in the summer of 1938. In the fall, as previously stated, they were analyzed for floret fertility. In sampling this population for analysis each tenth spike was selected.

From eighty such spikes the following major determinations are made: average number of spikelets per spike; average number of florets per spikelet; percent of fertile florets; number of fertile florets per spike and the number of fertile florets per spiklet.

To determine seasonal variation, if any, these investigations were continued through 1939 and 1940. Larger collections were made the second and third years but the same sampling methods were used except that each twentieth spike was selected for analysis. Since approximately two thousand spikes were selected both the second and third year the total number analyzed each year was about the same.

These selections were made along fence rows and waste ground at the extreme south edge of the Purdue University Campus and adjacent to a large gravel pit. This soil is droughty but has produced fairly good crops of wheat and alfalfa. This land is classified as a Warsaw silt loam.

The temperature and rainfall records were from the Purdue University weather station about 60 rods from the quackgrass plots.

Experimental Results

Table I records the results obtained for the three year period.

TABLE I. Quackgrass Fertility Analysis

	Year			
	1938	1939	1940	Average
Number of heads selected for analysis	80	93	95	89.3
Total number of spikelets	1531	1581	1727	1613
Ave. Number spikelets per spike	19.14	17.0	18.71	18.28
Total number of florets	6736	7715	7783	7513
Ave. number of florets per spikelet	4.4	4.88	4.38	4.62
Ave. number fertile florets per spikelet	.49	.13	.78	.48
Ave. number fertile florets per spike	9.39	2.21	14.59	8.79
Percent of total florets fertile	11.2	2.7	17.4	10.27

Floret fertility, on a percentage basis, was found to be 11.2, 2.7 and 17.4 for each of the years, 1938, 1939, and 1940, respectively. The average number of grains ranged from 2.21 to 14.59 per spike and from 0.13 to 0.78 per spikelet. Even in the most favorable year less than one grain per spikelet was produced.

The floret analysis herein reported includes the total number of florets within the spikelet. It is generally known that, in the many-flowered spikelets in the grasses the percentage of floret fertility decreases from the lower to the upper nodes of the rachilla. Quackgrass appears to be in general agreement with this fertility pattern.

Weather records were obtained to correlate if possible temperature and precipitation with fertility.

Climatological data (1) giving precipitation and temperature recorded as departure from normal are presented in Table II.

TABLE II. Precipitation and Temperature Data Obtained from Climatological Reports.

Months reported	Figures recorded as departures from normal					
	1938		1939		1940	
	Precp.	Temp.	Precp.	Temp.	Precp.	Temp.
May	+1.67 in.	+0.6°F.	—3.35 in.	+5.1°F.	0.0 in.	—1.6°F.
June	+0.03 in.	—0.1°F.	+1.36 in.	+3.9°F.	+0.39 in.	+2.1°F.

These figures indicate that the year of highest June rainfall was accompanied by the lowest floret fertility, while in years when June rainfall was more normal floret fertility was higher. The figures further show that 1939 was the year of highest June temperature and was associated with the lowest floret fertility. Due to the flowering period of quackgrass it appears that May rainfall would have less influence on floret fertility than would rainfall in June. In Central Indiana quackgrass flowers the first half of June, sometimes starting in late May. Generally, however, the flowering period is over and the grains quite well matured by early July.

Discussion of Results

In general weeds produce seed in very large numbers. One investigator (6) found that some weeds produce several hundred thousand seeds per plant while in a few cases the estimate (Peterson and Tingy, 8) has been up to a million seeds per plant. In general the weedy species in the grass family produce less seed than do many weedy plants in other families.

All weeds branded as primary noxious by law in Indiana (Quackenbush and Carter, 9) propagate vegetatively as well as by seed. In general, where vegetative reproduction is well developed the plant has reduced its tendency to reproduce by seed. This reduction in seed may be

caused by a reduced number of flowers or by flower sterility. There is ample evidence of floret sterility in many of the grasses. It is well known that vegetatively Canada thistle, *Cirsium arvense* (L.) Scop., and field bindweed, *Convolvulus arvensis* L. spread rapidly by vegetative reproduction yet neither of these two species produces many seeds in this area. On the contrary, Johnson grass, *Sorghum halepense* (L.) Pers. is very aggressive vegetatively yet with little apparent reduction in its ability to produce seed.

While rhizomes and creeping roots are effective in the dissemination of weedy species they are most effective when carried short distances. Seeds, however, often retain their viability for many years, and may be carried great distances by means of agricultural seed or other agencies.

While quackgrass under the conditions of the experiment produced few seeds in this area one would not be entirely justified in assuming that such seed is a negligible factor in the spread of this weed. According to the data presented quackgrass produces some seed every year and an appreciable amount of seed in the more favorable years. Such seed is no doubt a very definite factor in the dissemination of the species, being carried through forage crops, crop residues, manure, and agricultural seed. Such seed provides a constant source of infestation of new areas.

These results indicate that high temperature or heavy precipitation or both may reduce floret fertility in quackgrass. Although definite conclusions should not be drawn from three years data these results are in general agreement with greater floret fertility found in the western and northern states where lower temperatures and rainfall prevails. The separate effects of these two factors are not known.

Summary and Conclusions

Floret fertility of quackgrass, *Agropyron repens*, as determined by the number of seeds found at maturity was relatively low in central Indiana. There was considerable annual variation.

Higher than normal June rainfall and higher than normal June temperature were associated with reduced floret fertility.

Quackgrass sets some seed every year and an appreciable amount during the more favorable years.

When the usual methods of seed dissemination are considered even low yields of quackgrass seed must be an important source of infestation for new areas.

Literature Cited

1. ARMINGTON, J. H. 1940. Climatological data. Indiana Section. U.S.D.A. Weather Bureau. May-June 1938-1940.
2. ARNY, A. C. 1928. Quackgrass Control. Minn. Agr. Ext. Div. Circular 25.
3. DEAM, CHARLES C. 1929. Grasses of Indiana. pp. 101-102, Indiana Department of Conservation. Indianapolis, Indiana.
4. HITCHCOCK, A. S. 1935. Manual of the Grasses of the United States. U.S.D.A. Miscl. Publ. No. 200. pp. 231-233. Washington.

5. KEPHART, L. W. 1923. Quackgrass U. S. Dept. Agr. Farmers Bulletin 1307.

6. MUENSCHER, W. C. 1935. Weeds. pp. 4-5, Macmillian Co. New York.

7. OSWALD, W. L. and ANDREW BOSS. 1913. Minn. Weeds. Minni. Agri. Exp. Sta. Bul. 129.

8. PETERSON, W. and D. C. TINGY. 1928. Weeds. Losses, Agencies in Distribution, Nature and Control. Utah Agri. Exp. Sta. Cir. 71.

9. QUACKENBUSH, F. W. and A. S. CARTER. 1946. The Indiana seed law and how to comply with it. Purdue Univ. Agr. Exp. Sta. Circ. 313.