Ergot tolerance in spring rye

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In field plots in Saskatchewan, spring rye flowered later and showed higher levels of ergot infection than fall rye. Among three spring rye cultivars tested, Gazelle was consistently lower in percentage by weight of ergot sclerotia in seed samples, as well as being substantially higher in seed yield. Floret inoculation tests demonstrated that Gazelle does not possess physiological resistance to ergot. Gazelle showed less infection probably because the florets were pollinated more rapidly and more completely than those of the other cultivars.

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En parcelles d'essais installees en Saskatchewan, le seigle a fleuri plus tard et a été plus gravement touche par l'ergot *[Claviceps purpurea]* que le seigle d'automne *(Secale cereale).* Des trois cultivars testes, c'est Gazelle qui a montré le plus faible pourcentage de sclerotes d'ergot par poids dans les echantillons de grain, ainsi qu'un rendement en grain sensiblement plus élevé. Les epreuves d'inoculation des florules révèlent que Gazelle ne possède pas de resistance physiologique a l'ergot et s'il a ete moins atteint, c'est que sa pollinisation a été plus rapide et plus complete que chez les autres cultivars.

Ergot, a common disease of cereals and grasses, is especially prevalent in rye. The causal fungus *Claviceps* purpurea (Fr.) Tul. infects the florets, prevents seeds from developing, and replaces some kernels with a large sclerotium or ergot body (Seaman 1971). In addition, alkaloids in ergot sclerotia may cause poisoning when ingested by animals, poultry, and humans. The concentrations of poisonous alkaloids in ergot sclerotia vary among strains and samples but as little as 0.1% ergot in the feed or diet is considered to be potentially hazardous to health. The Canada Grain Act specifies that the highest grades of rye intended for milling should be free from ergot. Rye containing more than 0.33% ergot sclerotia by weight is graded ergoty.

After the initial infection of florets by ascospores from overwintering sclerotia, the fungus produces conidia, which are spread by rain and insects to later-flowering suscepts. Therefore, late maturing, naturally cross-pollinated cereals and grasses may show high levels of ergot infection. Spring rye, in particular, flowers later than fall-sown rye and may be severely infected by conidia from neighboring fields of fall rye or perennial grasses. Seed treatment with fungicides does not control ergot, and there are no resistant cultivars of spring or fall rye (Seaman 1971). Therefore, control methods must be designed to limit the availability of spores of the pathogen and to grow crops that flower at the same time and for as short a period as possible.

Platford and Bernier (1970) reported that a cultivar of spring wheat and another of durum wheat possessed significant degrees of resistance to ergot. Recently a new, high yielding cultivar of spring rye named Gazelle appeared to be less susceptible to ergot infection than other cultivars of spring rye (Sosulski and Curran 1975). The present study was undertaken to determine the level of ergot contamination in seed samples of spring rye cultivars grown in field experiments during 1973 and 1974 in Saskatchewan. These results were compared with the percentages of ergot in seed samples of fall rye cultivars.

Materials and methods

Three spring rye cultivars were grown in replicated yield trials at three locations in 1973 and at four locations in 1974. The entries included Gazelle, a single plant selection from German ryes; S6204, a yellow-seeded genotype developed by Watkins and White (1964); and Prolific, the only commonly grown cultivar of spring rye in western Canada. In addition, five fall rye cultivars were grown in yield trials at Saskatoon in 1973 and 1974.

At harvest, plants from each plot were threshed in the field with a Vogel thresher which has only a minimal cleaning capacity. Loose straw was removed by hand, and the seed samples were bagged and weighed. Seed from the four replications in each test was bulked before storage. Ergot sclerotia were separated by hand from the 2 to 3 kg of seed of each cultivar in each test, and the ergot content reported as the weight of sclerotia expressed as a percentage of the total sample weight.

Results and discussion

Fall rye from the 1973 and 1974 replicated field trials had a low incidence of ergot infection. The cultivars Antelope, Cougar, Frontier, Kodiak, and Puma contained between 0.01% and 0.10% ergot in the two experi-

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Table 1. Relationship between percentage of ergot sclerotia and seed yield of spring rye cultivars in experimental plots at four locations in Saskatchewan

Spring rye cultivar	1973			1974				1973–74
	Saskatoon	Indi	Aberdeen	Saskatoon	Indi	Indian Head	Arcola	Average
	Percentage by weight of ergot sclerotia in seed samples							
Gazelle	0.04	0.00	0.01	0.65	0.41	0.57	0.01	0.24
Prolific 1	0.16	0.68	0.21	1.70	0.53	1.23	0.04	0.65
Prolific 2	0.13	0.88	0.16	1.82	0.68	1.66	0.05	0.77
S6204	0.14	0.51	0.33	1.46	0.93	2.10	0.06	0.79
	Seed yield, quintals per hectare							
Gazelle	31.4	28.9	30.5	28.4	14.7	25.0	26.9	26.5
Prolific 1	22.6	23.6	24.7	21.1	12.2	25.1	21.6	21.6
Prolific 2	23.6	24.6	24.9	21.0	12.2	19.9	21.4	21.1
S6204	23.0	25.1	24.4	15.8	11.7	12.8	18.3	18.7
LSD 0.05	4.2	2.4	2.4	1.5	2.1	—*	4.0	

* Due to flooding, only one replicate was harvested at Indian Head.

ments. The fall rye cultivars headed during the first week of June and the seed was mature about 1 month later.

The cultivars of spring rye headed after June 20 and ripened 1 to 2 weeks after the fall ryes. The percentages of ergot bodies in the spring rye samples were much greater than for fall rye in six of the seven tests grown in 1973 and 1974 (Table 1). The percentages of ergot were particularly high at Saskatoon, Indi, and Indian Head in 1974 when several samples contained over 1.0% ergot. The Arcola test in 1974 showed a low level of infection in the three cultivars.

In all spring rye tests the percentage of sclerotia in seed samples of Gazelle was lower than in those of the other cultivars (Table 1). The average ergot level in the seed samples of Gazelle was only one-third that of Prolific and S6204. The consistency of the differences in each test suggested that Gazelle contained specific tolerance or resistance to ergot infection of the florets or to the formation of ergot bodies after infection.

However, in subsequent single-floret inoculation tests in the greenhouse, Gazelle was found to be as susceptible to ergot as Stewart 63, a nonresistant cultivar of durum wheat (Platford and Bernier 1970). No differences were observed between the rye and the wheat cultivars in amount of honeydew produced and in number and final size of sclerotia formed. It appears that GAzelle does not possess physiological resistance to ergot.

Gazelle yielded about 24% more seed than Prolific in the 1973-74 series of tests (Table 1) and this factor may have accounted for the lower incidence of ergot sclerotia. Presumably Gazelle florets were pollinated more rapidly and more completely than those of the other cultivars, thus limiting the opportunity for ergot infection. Gazelle headed on the same date as Prolific (avg 48 days after seeding) and the seeds matured in 98 days for both cultivars (Sosulski and Curran 1975), so that a difference in date of flowering was not a factor.

Conclusions

Spring rye cultivars showed higher levels of ergot infection than fall ryes, which was probably due to their later period of flowering. Ergot infection of some spring rye plots exceeded 1.0% because of small plot size and close proximity to roadways sown to perennial grasses. It appears that natural infections in experimental plot areas are sufficient to demonstrate differences in tolerance or resistance to ergot by spring rye cultivars.

Gazelle spring rye was consistently lower in percentage of ergot sclerotia in seed samples from plots grown at seven locations in 1973 and 1974. Single floret inoculation tests demonstrated that Gazelle lacked physiological resistance to ergot. The lower incidence of ergot observed in this cultivar in the field was apparently due to a better flowering habit which allowed Gazelle to escape infection to a greater degree than other spring cultivars.

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