# Performance of a Prolific and a Non-Prolific Corn Hybrid in Central North Dakota

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The term prolific, formally defined as 'producing many young or much fruit,' is a trait sought by producers of any agricultural commodity. With corn (*Zea mays* L.) it is a term reserved for cultivars which regularly produce more than one ear per plant. Modern corn hybrids typically bear only one ear and are the result of at least 100 years of selection for plants that were easy to harvest, ears which could win corn shows, and seed which was usually selected from the largest ears (Collins et al., 1965).

Though single-eared corn hybrids have many desirable attributes, prolific hybrids have frequently been found to be more stress tolerant (Collins et al., 1965; Hallauer and Troyer, 1972). Since corn produced in central North Dakota is stressed from temperature extremes, drought, and growing seasons which are often too short, we became interested in comparing the performance of a prolific versus non-prolific hybrids. The objectives of this study were to compare the performance of a commercially available prolific and non-prolific hybrid under both dryland and irrigated management and determine if the characteristics of the one prolific hybrid chosen would suggest further development of short season prolific hybrids.

## PROLIFIC CORN IN NORTH DAKOTA

To the modern corn breeder and producer alike, the image of a prolific corn hybrid is for multiple ears to occur on a single stalk (Figure 1). The southern prolifics and most of the literature on prolifics versus non-prolifics (Collins et al., 1965; Hallauer and Troyer, 1972; Prior and Russel, 1975) are concerned with single-stalked, multiple-eared hybrids, a plant design which has been easily adapted to. Prolificy due to multiple stalks from a single plant, each bearing one or more ears, has not been favored. The U.S. corn grower has referred to multiple stalk prolificy as 'suckered' corn although the benefits of tiller production under most situations has been periodically demonstrated (Wiancko, 1911; Dungan, 1931; Rosenquist, 1941). Multiple stalk prolificy may be a yield stabilizing trait in production fields but seed producers find it unacceptable if the female parent must be detasseled more than once. Prolificy of corn in North Dakota is more of the 'suckered' type because of plant size, genetics, and cool temperatures.

Corn of the maturity needed for North Dakota has fewer and smaller leaves than longer season hybrids grown farther south, thus less photosynthate is available for filling multiple ears per stalk. If multiple ears are to be produced per plant, then leaf area must be increased by faster growth rate or through tillering.

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**Figure 1. Basic design of single plants of non-prolific, multiple ear prolific and multiple stalk prolific type corn hybrids.**

'Dent' corn is the major kind of corn grown today in the U.S., but even modern cornbelt hybrids have both 'northern flint' and 'southern dent' ancestors somewhere in their history. Northern flints typically tiller profusely and are a source of early maturity and cold tolerance while southern dents are associated with high yield potential and stalk strength. The early maturity and cold tolerance needed for North Dakota corn obviously must draw heavily from the flints or their derivatives even though today's hybrid may appear to be a 'dent.' Corn varieties grown in what is now North Dakota by Indians at least 500 years ago were flints (Will and Hyde, 1917) which were the common varieties grown until the 1900s when the yield advantage and harvest ease of the flint/dent combination was being noted. The transition away from flints to dents in central North Dakota is best summarized by an excerpt from the Annual Report of the Edgeley Experiment Station in 1909:

> *"Northwestern Dent is the best for general planting in this district. It is evidently a cross between a flint and a dent variety and invariably ripens more corn than any of the dent strains now growing in this locality. The ears are placed well up on the stalk. . .one of the greatest drawbacks found in many of the flint varieties is their tendency to grow ears close to the ground and this greatly interferes with harvesting the crop."*

The 1905 corn variety trial at Edgeley consisted of seven flint and five dent entries. By 1912 there were six flint and 11 dent varieties. At the Carrington Station in 1983, a year where flint entries were encouraged after the short growing season of 1982, the dryland corn performance test included six flint and 42 dent hybrids. Though modern hybrid development has utilized dent strains for yield improvement, further gains in cold tolerance and early maturity may depend upon flint germplasm which will also contribute the ability to tiller unless specifically bred out. The corn most adapted to North Dakota is found in the genetics of 'suckered' corn.

Grasses typically tiller during early vegetative development and corn is no different. Tillers are indicative of a favorable environment and have been reported to contribute up to 70 percent of the total yield in thin stands of wheat (Bremmer, 1969). Tiller initiation also seems associated with cool temperatures which seem to trigger development (Rawson, 1971). The importance of temperature in stimulating tillering in corn has been explored for several years by Minnesota researchers who have found differences of 10°F on the five-leaf corn seedling, enough to either promote or inhibit tillering (Jeppson and Crookston, 1986). Early planted corn in North Dakota is assured of being exposed to temperatures which will promote tillering.

## PROLIFIC VS NON-PROLIFIC HYBRID AT CARRINGTON

The dryland corn producer in central North Dakota must anticipate the conditions for the coming season when planting his crop. Today's common non-prolific hybrids require low plant populations during dry conditions, but yield potential is sacrificed with low plant populations if favorable precipitation is received. To assess whether a prolific hybrid could help stabilize yield potential under these conditions, a high performing non-prolific ('Pioneer brand 3978') and prolific hybrid ('P-A-G brand SX111') were chosen from the hybrids previously observed in the corn performance tests at Carrington. They were planted in six-row plots spaced at 30-inch intervals and thinned to establish 10, 15, 20, 25, 30, and 35 thousand plants per acre, replicated three times each on dryland and under flood irrigation. The study was conducted in both 1982, a short season with delayed planting due to rain followed by an August freeze, and 1983, a season of normal length with favorable precipiation early followed by hot, dry conditions during later July and August.

Results were pooled and are expressed in Figures 2 and 3. Maximum yields were obtained from the non-prolific hybrid which was dependant upon high plant populations. The prolific hybrid was lower yielding than the non-prolific hybrid except at the lowest plant population but maintained yield stability over a range of plant populations which represent the lowest risk.

The contribution of yield from tillers also is illustrated for both hybrids. Pioneer 3978 strictly adhered to its preference for only one ear per stalk, but did tiller at low plant populations achieving roughly half the productivity of the tillers from P-A-G SX111. The two years of contrasting conditions influenced the performance of tillers, especially under dryland conditions. In 1983 the hot, dry period which occurred around silking prevented emergence of the tiller silks. Tiller yield from P-A-G SX111 at 10,000 plants per acre in 1983 averaged only 3.8 bushels per acre on dryland while irrigated plots averaged 29.3 bushels per acre from tillers. Evidently it was moisture stress and not high temperature effects which was responsible for failure of tillers to yield grain.

While yield stability over a wide range of conditions is one favorable attribute of prolifics, it has also been suggested that prolifics be used under high yield/high plant population en-

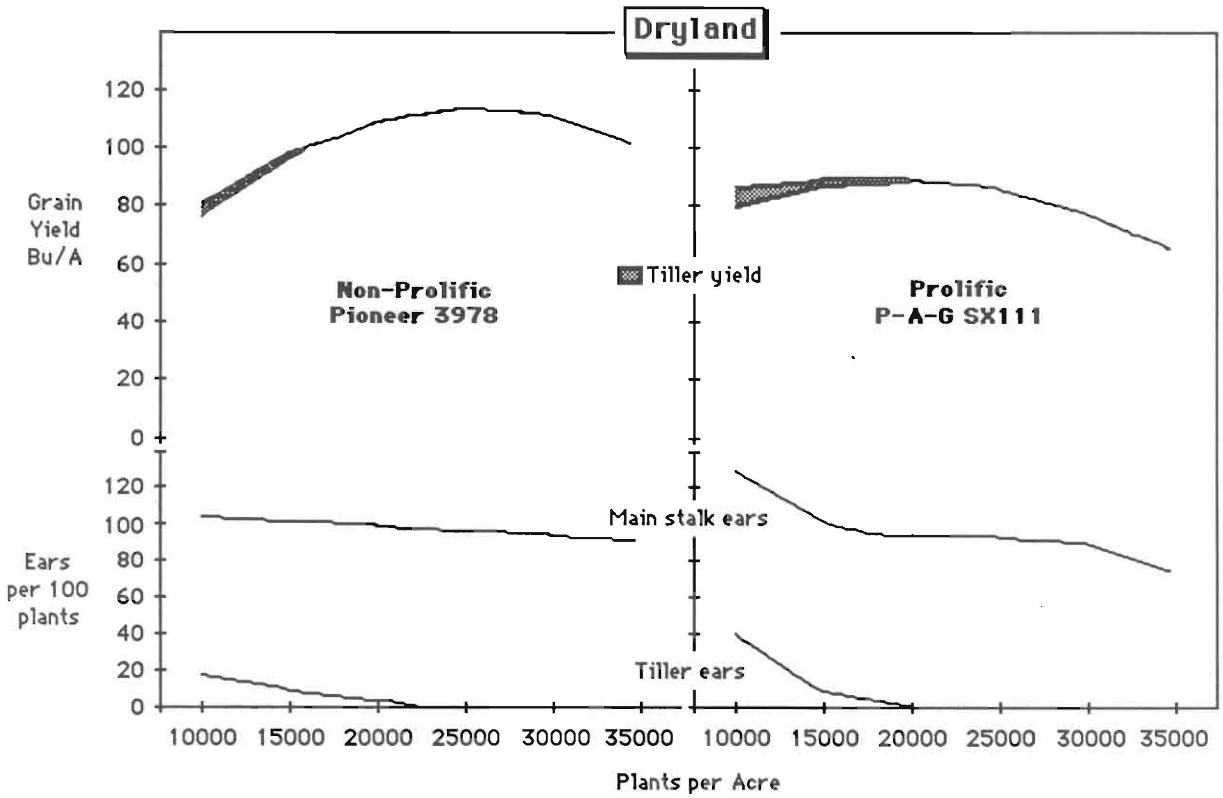


**Figure 2. Dryland grain yields and ears per hundred plants found on main stalk and tillers as predicted by regression.**

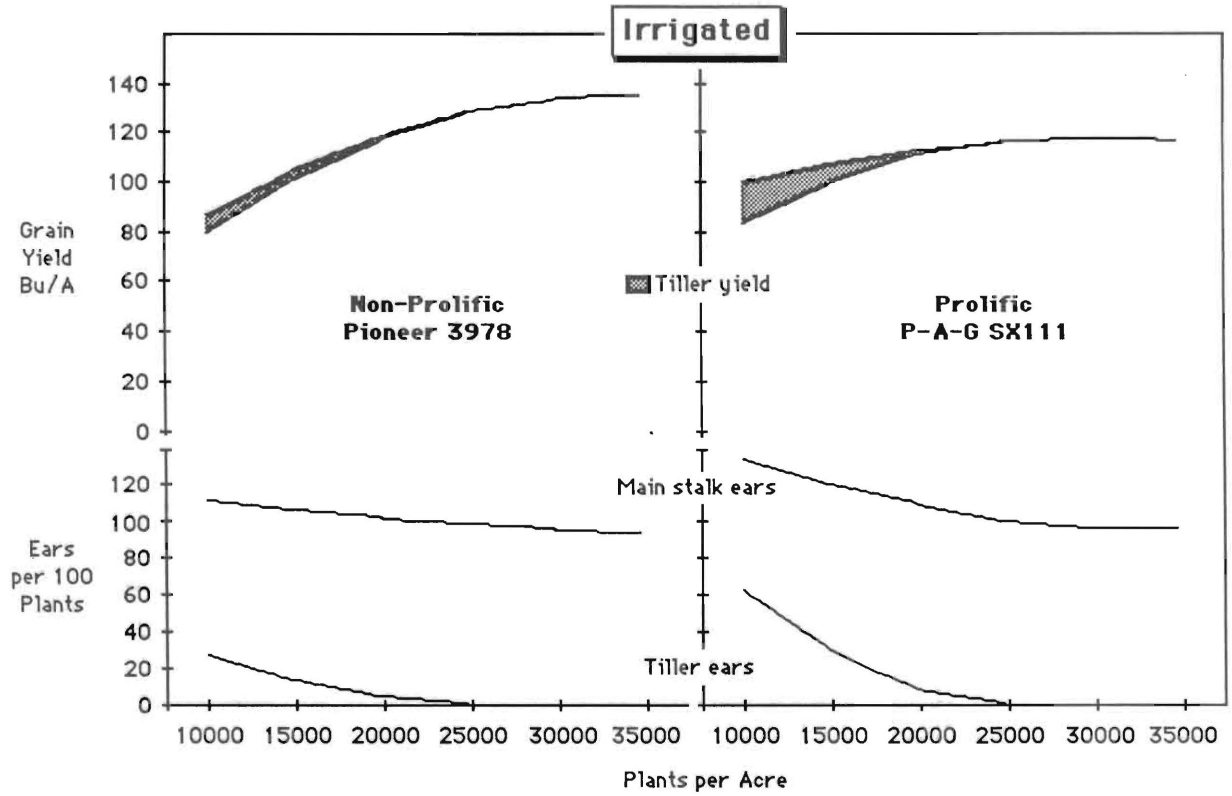


**Figure 3. Irrigated grain yields and ears per hundred plants found on the main stalk and tillers as predicted by regression.**

vironments to reduce the number of barren plants (Prior and Russell, 1975). Generalizations should not be drawn from these data since only two short season hybrids were observed, but it should be noted that it was the prolific, not the non-prolific, which went barren under high plant populations. Multiple stalk prolificy may be less suited to high yield environments than multiple ear prolificy.

The production of one stalk per plant and one ear per stalk has commonly been used as a quick indicator of proper plant population for any given hybrid. Both hybrids in this study reached this equilibrium at approximately the same planting rates; 17,000 plants per acre on dryland and 24,000 plants per acre under irrigation (Figures 2 and 3). For the prolific hybrid these populations produced maximum yield. These populations were below the planting rates necessary for maximum yield for the non-prolific hybrid, however, which on both dryland and under irrigation achieved maximum yields with plant populations which produced 5-8 percent barren plants.

## CONCLUSIONS

General recommendations for plant populations or the performance of prolific versus non-prolific classes of corn in central North Dakota cannot be formulated from the observations of only two hybrids. The objectives of this study were to compare the best prolific and non-prolific hybrid presently available and determine if prolificy should be further explored. Highest yields were obtained from the non-prolific hybrid but at higher, riskier, plant populations than presently recommended. The prolific hybrid was lower yielding but maintained stable yields over a wide range of plant populations. Based on these results, two strategies of corn production could develop.

On dryland, especially on soils of limited water holding capacity, it appears that conservative plant populations, from 10,000 to 17,000 plants per acre with a hybrid that freely tillers, would be the best compromise between risk and yield potential. For this strategy to work, however, a hybrid must be developed which will set tiller ears under conditions similar to those experienced in 1983 with first favorable, followed by dry, conditions. A problem similar to that exhibited by P-A-G SX111 has been reported among multiple ear prolifics, with some hybrids first satisfying the main ear before feeding any secondary ears, while others will feed all ears at nearly the same rate (Tsotsis, 1972). Multiple stalk prolifics must be developed which, once tillered, will not succomb to the dominance of the main stalk but instead provide for their own silk emergence and eventual ear formation. Tillers of this type are found on many successful crops of the Great Plains such as wheat and barley.

If a non-prolific, such as Pioneer 3978, is to be grown at higher plant populations on dryland, the water requirement of the additional plants must be satisfied to achieve optimum yields. Based on soil moisture data taken in 1982 from the Pioneer 3978 plots, the jump in plant population from 15,000 to 25,000 plants per acre used an additional 1.33 inches of water (Figure 4) but did result in a 15.6 bushel per acre yield increase.

In contrast to dryland corn production, the strategy for producing irrigated corn is less complex. The predictable development of a non-prolific hybrid such as Pioneer 3978,

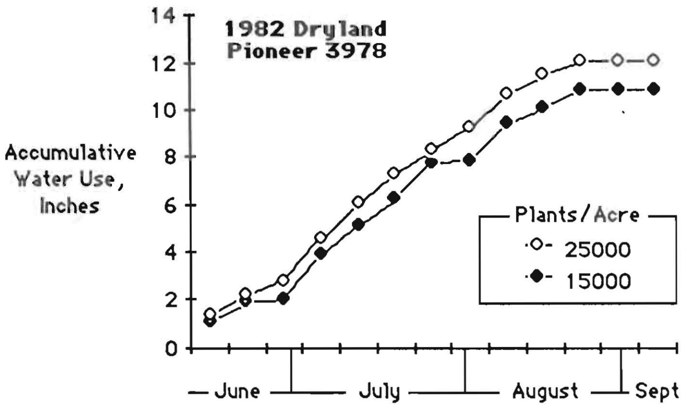


**Figure 4. Mean accumulative water use for Pioneer 3978 on dryland in 1982 for the 15,000 and 25,000 plants/acre treatments.**

where an established plant is essentially an ear, can be of great value in an environment where precipitation can be controlled. Based on these data a non-prolific hybrid established at relatively high plant populations would be the choice for high yield, irrigated environments. To fully realize the yield benefits from such a strategy, however, other management practices such as water, fertility, and pest management become even more critical as maximum yields are approached.

In summary, a prolific corn hybrid was able to help achieve yield stability in central North Dakota though it did not have the yield potential of a non-prolific hybrid. There does appear to be potential in the development of prolific corn hybrids which will most benefit the dryland North Dakota corn producers.

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Dockage is weed seeds, chaff, straw, insect parts, dust or light material, etc. and can contain some small kernels or pieces of wheat or barley kernels. Foreign materials in wheat is the "material other than wheat" in a wheat sample after dockage removal. Sprout or other damage to wheat kernels and mixtures of kinds (classes) of wheat, e.g., durum wheat in hard red spring wheat, also influence wheat grades.

I believe that farmers should be more familiar with the grading of grain. This knowledge should be useful especially in these times of low cash prices for grain, the use of extensive farm storage of grain, the availability of high protein premiums for high protein hard red spring wheat, and the increasing use of "unit trains" to market grain.

A farmer can use the grain grading system even without detailed knowledge of the actual physical grain grading process. The farmer can take a **representative sample** of grain being loaded into farm storage and send the sample to a licensed inspector at Fargo, Grand Forks, Jamestown or Minot to get a Submitted Sample grade. The Submitted Sample Certificate will report the physical nature of the grain and provide the essential information needed for effective marketing. The farmer can use this information to merchandise his grain more effectively, hopefully to obtain a greater cash price. The information on the Submitted Sample Certificate should be mutually useful for the farmer and the elevator seeking to make up a unit train of grain having similar or same quality or grade.

The **representative sample**, which is a small sample representing a much larger lot, is very important and information is available on how to take the sample with a coffee can or similar device that costs nothing, and is as accurate as a more expensive special device. The sampling device is passed through the grain stream falling from the truck endgate at several intervals during unloading of the truck. (See article on page 3 of this issue.)

Controversy exists on whether a farmer should clean grain to remove some dockage and foreign material on the farm. Most grain contains some dockage and foreign material. Bill Wilson, an NDSU agricultural economist, has calculated that cleaning grain to remove dockage and foreign material on the farm will cost 14-17 cents per bushel. It is doubtful that the clean grain would have increased value of 14-17 cents per bushel after cleaning in our present marketing system. The farmer would have difficulty recouping the cost of cleaning unless the "cleanout" or "screenings" could be sold for an amount more or less equal to the cleaning cost. More market research needs to be done on the economic considerations to cleaning grain on the farm or at the elevator before sale. But, farmers should use the grain grading system to improve marketing efficiency and return on cash grain.