

## Establishment of Meadowfoam as a New Crop in Virginia

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Meadowfoam (*Limnanthes alba* Benth., Limnanthaceae), a low growing winter annual native to northern California and Southern Oregon (Ehrensing et al. 1996), was domesticated at Oregon State University (Franz et al. 1992). The natural habitat of meadowfoam is 35° to 45° N latitude. Meadowfoam seed oil contains long-chain fatty acids (20- and 22-carbon). These fatty acids are unique due to very high levels of mono-unsaturation and very low levels of poly-unsaturation. These characteristics make meadowfoam oil very stable, even when heated or exposed to air. Meadowfoam oil is useful in manufacture of high quality waxes, lubricants, detergents, and plasticizers. The unique fatty acid profile and special properties of meadowfoam oil and its derivatives have also stimulated interest in its use in personal care products such as cosmetics and toiletries. Oil from meadowfoam was first tested in the late 1950s as part of a US Department of Agriculture search for plants to provide new raw materials. Meadowfoam is well adapted to the relatively mild winters and warm dry winters of the Pacific Northwest and is known to grow well in many types of soil including poorly drained areas.

Currently, meadowfoam is produced on about 3000 ha in the Willamette valley of Oregon (Ehrensing et al. 1996) by Oregon Meadowfoam Growers Association (OMGA). However, this production is insufficient to meet the demands of chemical and cosmetic industry. Due to the fact that meadowfoam in Oregon is produced in rotation with grass seed production, an increase in meadowfoam area in Oregon is not possible. OMGA has been interested in expanding the production of meadowfoam due to increasing demand for oil and to stabilize meadowfoam oil's availability. The objectives of this research were to determine feasibility of meadowfoam production in Virginia; develop an agronomic system for meadowfoam production; and facilitate meadowfoam production in Virginia.

### MEADOWFOAM RESEARCH IN VIRGINIA

The meadowfoam research was initiated by the New Crops Program of Virginia State University in 1992. Previous research conducted in Virginia had indicated that meadowfoam production in Virginia may not be possible. However, because of increasing demand for meadowfoam oil, it was decided to plant a preliminary, observation-type plot (36 m<sup>2</sup>) with 'Mermaid' cultivar during 1992–93. The meadowfoam plants grew well and produced seed. A similar observation plot was again planted during 1993–94 using the seed produced during 1992–93. The meadowfoam in these observation plots matured and produced seed (Bhardwaj and Wohlman 1997; Bhardwaj and Parrish 1998).

Based on these results, a replicated experiment was conducted during 1995–96 season, using 'Mermaid'. In this experiment, five nitrogen rates were evaluated in a randomized complete block design with three replication. This experiment was planted on Nov. 25, 1995. A second experiment was planted on Feb. 26, 1996. Both these experiments were successful. During 1995–96 season, the seed yield varied from 494–606 kg/ha with a mean of 494 kg/ha (Table 1). The mean oil content of this crop was 22.8% whereas the mean long chain fatty acid content was 92.4%. Based on this success, Fanning Corporation (Chicago, Illinois) supported commercial production of four ha of meadowfoam in cooperation with two Virginia farmers during 1996–97. This crop was planted on Dec 12, 1996 with 25 kg seed per ha. This crop received 45 to 70 kg/ha of nitrogen. The meadowfoam was in full bloom by May 9, 1997. Eight beehives were placed in each 2 ha field. The crop started to mature during last week of May, 1997. We tried using various harvesting techniques without much

**Table 1.** Performance of 'Mermaid' meadowfoam in Virginia.

Year	Seed yield (kg/ha)	Oil content (%)	Long-chain fatty acids (%)
1995–96	494 (251–606)	22.8 (21.0–25.0)	92.4 (92.3–92.5)
1996–97	408	26.0	97.0

success. The meadowfoam was eventually direct combined from June 9–11, 1997. The seed moisture content at this time was 14–18%. The direct combining caused approximately 38% loss due to shattering. The average yield from direct combining was 284 kg/ha. At the time of direct combine harvesting, we harvested four 1 m<sup>2</sup> plots from one farmer's field, by hand, to estimate the actual seed yield. In these plots, the yield level was 408 kg/ha (Table 1). The oil content in this crop was 26% and average long-chain fatty acid content was 97%. Additional research indicated that reduction in seed moisture from 60% to 32% (Table 2) did not significantly reduce the oil content and the long chain fatty acid content. However, based on recommendations from Oregon State University, it might be desirable to swath meadowfoam when the seed moisture is about 42% until substantial data for optimal seed moisture content in Virginia are available.

During 1997–98, eight Virginia farmers planted approximately 50 ha of meadowfoam in cooperation with Oregon Meadowfoam Growers Association. This crop was generally unsuccessful. Possible reasons for this failure were judged to include: use of an unadapted cultivar, late application of Select herbicide and liquid nitrogen fertilizer, and unsuitable weather for bee foraging at flowering. For the 1998–99 season, approximately 40 ha of meadowfoam has been planted.

## CONCLUSIONS

Experimental results indicated that meadowfoam can be grown in Virginia as a winter crop with acceptable seed oil content and quality. Row spacing of 15–30 cm appears optimal and nitrogen needs may be up to 100 kg/ha. The commercial meadowfoam production efforts in Virginia during 1996–97 and 1997–98 seasons suffered from inadequate weed control and lack of harvest technology. The research conducted by Oregon State University scientists has identified herbicides for weed control. We plan to evaluate these herbicides in Virginia to determine optimal rates. In the meantime, plans include to obtain state registrations of two herbicides (Select for grass weed control and Stinger for broadleaf weed control) to meet a special local need [Pursuant to Section 24(C) of the FIFRA] for use in meadowfoam production fields during 1998–99 season. Virginia State University has purchased a swather and a belt pickup attachment for a combine for harvesting of meadowfoam. This equipment will be provided to the farmers. One farmer, who planted approximately 16 ha during 1997–98 season, purchased his own swather and belt pick-up for his combine and is expected to help other farmers with their meadowfoam harvesting operation. It is planned that the meadowfoam crop during 1998–99 will be harvested using swathers at about 42% moisture in the seed, left in the field in windrows to dry, and then combined using the belt pickup attachment.

Our experience with meadowfoam indicates that meadowfoam can be grown in Virginia as a winter crop with acceptable content of oil in the seed, and content of long-chain fatty acids in the oil. However, the successful introduction of meadowfoam into Virginia will depend upon development of adapted cultivars, successful weed control strategies, and efficient harvesting practices.

## REFERENCES

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**Table 2.** Effect of harvest date on 'Mermaid' meadowfoam quality.

Date of 1997 harvest	Moisture (%)	Oil (%)	Long-chain fatty acids (%)
May 28	79.5a <sup>z</sup>	17.6d	87.3c
May 30	74.7b	21.9c	93.7b
June 4	60.3c	24.3b	96.1ab
June 9	31.8d	24.7ab	96.4a
June 12	15.9e	26.0a	97.0a

<sup>z</sup>Mean separation in columns by Duncan's Multiple Range Test, 5% level.