C R A N B E R R Y 2 0 0 0

FINAL REPORT

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Cranberry 2000

In reviewing the progress of the cranberry industry in the state of Maine, it is to be noted that there has been no real progress and technical help provided for prospective cranberry farmers. The University of Maine at Orono, did hold a one day conference at Orono concerning the development of a cranberry growers guide. The draft guidelines were supposed to be updated by early spring in time for this year's growth, but because of "I assume" budgetary shortfalls, the final guidelines were not completed until late fall. Many of the concepts and recommendations seem to have originated in theory without any practical applications to the farmer. For example, it is imperative that when berms are constructed, erosion control measures be instituted immediately. I could not even get the local soil and water conservation district to make a recommendation as to the type of vegetation cover that would best be suited for this problem. To date the test plots that we constructed for our cranberry 2000 project are the only ones in existence. I have had the opportunity to show them at various times during this summer to more than two dozen prospective growers. As the summer evolved I discovered that there were far more questions arising than there were answers available. With this in mind, I would like to present my findings to date for this project.

SITE SELECTION

The choice of the site consisted of a active blueberry field, and a small patch of woodland. Using a transit we established some grades and laid out the plots. We conducted soil samples using an 18" probe and determined the soil to be of a Lamoine-Buxton complex. Having utilized soil conservation district's soil profiles, it was determined that the prospective site had very low permeability. In theory, it appeared to be an excellent site with no wetlands involved.

WATER SUPPLY

The water supply consisted of an irrigation pond already in existence since the mid 1960's. The pond is about 3/4 of an acre in size averaging 3-4 feet in depth, and being replenished by springs in its bottom.

Since our community was in the process of updating its municipal water supply, and since my father was the district's water superintendent I was able to obtain a fire

hydrant which I placed on the edge of the pond. This was much easier for hooking up suction lines than using suction hoses dropped in the pond.

EARLY SPRING

The spring of 1993 was extremely wet. In March and April we experienced 12.13" of rain, and 36" of snow. (See weather charts) I had anticipated bringing in the excavator relatively early, but because of the lack of cooperation from mother nature, this was not possible. While waiting for good weather I spent my time building a cranberry disk planter and modifying weed rollers that I had built for wiping weeds on blueberry fields. In addition to these projects, my father and I interviewed a number of "old timers" who did relate going cranberrying in the fall and stocking up for the winter's "larder". It was suprising to note that some of the interviews told of many types of native cranberries. Some of these cranberries were speckled in nature, some were round, and some were pink, and some were pear shaped. There were also accounts that told of unusually large berries growing in the wild, similar to those of the hybrid "Stevens".

Early in March Lynch Hill Farms ordered 2.5 tons of cranberry vines from Doug Beaton, while negotiating with Mr. Beaton he stated that he would get us a number of different varieties of cranberry vines for this project. A check for $5500.00 dollars was sent as a down payment to insure that the vines would arrive. It was anticipated that the Massachusetts vines would be of the following varieties. Stevens, Crowleys, Ben Lear, Howes, Early Blacks, Lemunyon, Pilgrims, and Macfarlins. The local varieties would come from those areas that the "old timers" had told us about.

CONSTRUCTION OF BEDS

As the spring progressed, mother nature began to cooperate and the land began to dry out. I obtained a Kobelco 907 excavator and proceeded to bring the beds to grade. Test plots were laid out six feet wide with a four foot walk space between each bed. Halfway through the test plot construction, a decision was made to construct an additional two growing mediums. Consequently, the growing mediums were expanded to:

1. 4" - 6" of sand on a clay base.
2. Peat base
3. 6" compressed straw with 4" of sand on clay base.
4. Undisturbed top soil, mowed, with lumber cloth and 6" - 8" of sand over cloth.

The main test plots were taken to grade on Lamoine-Buxton-Scantic complex soil. The permeability of this soil is classified as slow to very slow in the subsoil and substratum. This soil was also very deep and was composed of glacio-marine deposits compressed by glaciation. An interesting sidelight in the construction process, where I ran into excessive amounts of surface water, was an attempt to drive a 2" schedule 80 pipe through this strata. I built a pile driver and sunk a series of 2" pipe sections 32 feet in depth. With a high pressure pump we washed out the pipe with water and determined a clay stratum of approximately 30 feet before experiencing sharp course gravel. After a day's wait there was no standing water in 32' well. Upon bringing these test plots to grade, four inches of sand was spread on the plots. This sand, perhaps a bit courser than is used in Massachusetts, yet relatively fine, came from the lower strata of a gravel pit (approximately 80 feet in depth) to ensure "clean" sand free of any seed banks.

The second plot's component consisted of the peat environment. This plot was located adjacent to the first beds and was elevated approximately 30 inches above the first. Some of the clay (almost liquid in nature) was interspersed with the peat, and this material turned to "cement" as the summer progressed.

The third test plot plot we built next to the irrigation pond. Since our area used to be primarily agricultural in nature, I felt that if potential growers were interested in developing old upland fields that some guidelines should be available to help the prospective farmers. We placed a cloth material used to cover lumber on the mowed field and then covered it with sand. The edges of the test beds did not have any cloth material and consequently the grasses easily grew through the sand layer.

The last test plot we constructed, was located on the Webb District Road in Harrington, where Lynch Hill Farms Inc. was constructing 5 acres of bogs. We placed approximately 6" of compressed straw on the clay base and then covered the same with 4" of sand. My rationale here was to create a "spongy" layer that would retain water and not be so susceptible to drying out quickly.

IRRIGATION SYSYEM INSTALLATION

In preparing the irrigation system, we used high density polyethylene pipe in sizes of 1.25" and 1.5". We hand dug the trenches to place the pipe in and made some 3/8" rerod staples to hold the coiled pipe in place. After the pipe had been laid, a bit stock with a hole saw was used to drill a hole in the pipe so that a 3/4" brass saddle might be screwed into place. Once the saddles were in place, an 18" x 3/4" schedule 80 plastic pipe was threaded and a sprinkler head installed. In order for the sprinkler heads to stand straight, I

had to place some metal rods into the clay and then wire the sprinkler heads to them. The sprinkler heads were spaced on a 50' x 60' pattern. This was the recommended plan from the irrigation concerns we had contacted. Perhaps that spacing pattern needs to be changed in the future after having read "Solid Set Sprinkler Irrigation System" in the Cranberry Magazine (December 1993). The sprinkler heads that were used were of three types.

1. Rainbird #30h 1 nozzle 5/32" in diameter.
2. Rainbird #30h 2 nozzles 1- 5/32" in diameter, and one spray nozzle 1/8" at 20°.
3. Rainbird # 70 2 nozzles 1- 1/4" in diameter, and one spray nozzle

OBTAINING VINES

With the beds prepared, all I was waiting for were the vines that had been ordered in March. On June 8, a letter was sent by Doug Beaton, a "reputable" vine dealer indicating that he was unable to obtain the vines. Consequently, I quickly made some phone calls to a representative of the Maine Cranberry Growers Association to see if they could help me. I obtained vines in West Pembroke Mass. @ $2.15 lb. We were able to obtain Stevens, Howes, Crowleys, and the native varieties that we gathered ourselves, and which we placed in the irrigation ponds while waiting for the hybrid varieties to arrive.

APPLYING SAND TO THE BOGS

The 4" of sand that was spread on the bogs was applied just prior to planting to ensure that there were no seed banks established in the beds before planting. The sand was spread with a D-3 bulldozer on every test plot, with the exception of one in which the sand was spread by a farm tractor with a scraper blade attachment. After the sand was leveled by the bulldozer we attempted to use a rock rake behind a farm tractor to remove some of the larger rocks and an occasional piece of clay left from the excavation. We found that this was not an efficient use of time or machinery, and that it was much easier to just remove the largest rocks by hand, and to leave the smaller ones on the bog.

PLANTING OF THE VINES

After the sand was applied, and the irrigation system was installed, we began planting because of the rapidly dwindling growing season. Our first planting was on July 1, and planting continued until July 4. Before planting, the bog was irrigated to saturation to keep the vines from drying out. Immediately after the vines were spread, they were disced into the sand to a depth of 2.0 to 3.5 inches. We were not sure as to what depth of planting was best so in the process of building our disk planter we used two different sized disks, one set that planted to a depth of two inches, and one set that planted to a depth of three inches. After the vines were completely disked we rolled the vines with a roller to push sand into the grooves that the planter had made. This was to ensure that no air pockets were left at the site at which root development was to occur. After this planting process was completed the beds were irrigated for a period of four hours to keep the vines from being stressed by planting, and also to remove the few remaining air pockets left from the planting process.

IRRIGATION

Immediately after planting was completed, daily irrigation of the vines commenced. I watered each test plot for a period of two hours daily with the exception of rain days which were not many. In July we received only 1.96" of rain and this was mostly in the form of showers. We had only one soaking rain period of 12 hours which resulted in .76" of precipation followed by relatively cool temperatures. The "dog days" of summer settled in and irrigation continued daily. The entire month of August yielded only .74" of precipitation, all in the form of thunder showers. There was one extended period of 10 hours in which we received .25" of precipitation. Although the highest temperatures that we recorded never reached 100^{o}, on August 27, 1993 the digital probe, which is 2" above the level of the bog, rose from 104^{o} F at 11:45 a.m. to 117^{o} F at 12:25 p.m.. This rapid increase in temperature must have stressed the developing plants.

MONITORING EQUIPMENT

The monitoring equipment that was installed included a soil temperature probe, 2 irrometers, two rain gauges, and a digital high low thermometer which had a permanent probe placed three inches above the level of the bog. It was interesting that the soil

irrometers with their 10 inch bulb probes did not indicate any plant stress during the months of July and August. I established that due to the low permeability of the clay soil, and the fact that the probes were below the shallow fibrous root system of the cranberry plant that these measuring devices did not accurately record the water stress of the vines. Perhaps next season we will try using a 6" probe driven at an angle into the sand to give more accurate data on the stress of newly planted vines. Also in July Don Maiers, an entomologist employed by the Maine Department of Agriculture came to visit our test plots. His department was collecting data on the potential insect problems associated with cranberry production in the State of Maine. He supplied us with two types of pheromone traps to monitor the beds for cranberry girdler moths, and also the Sparganothis fruit worm moth. Both of these insects are native to the area, but at the present are existing in very low populations. During our two months of pheromone trapping, the traps from both sites yielded one cranberry girdler, and a total of 8 Spag fruit worm moths.

FERTILIZATION

During the month of July, no fertilizer was applied upon the recommendation of the East Warem Cranberry Experiment Station in order to allow the vines time to adequately develop a root system before being influenced by fertilizer, which could possibly burn the fine new roots. Commencing in August, I purchased fertilizer from the President of the Maine Cranberry Growers Association at an NPK formulation of 12-15-30. This was his recommendation against my better judgment. Being a experienced blueberry grower, I knew that phosphorus and potassium were primarily intended for increased fruit bud development and this was not what I wanted to stress. I wanted vine growth and after making some phone calls to cranberry growers in Mass., I applied 10-10-10 fertilizer for a more balanced application that I applied at 10 day intervals.

OBSERVATIONS AND CONCLUSIONS

During the course of the summer we monitored the development of weeds growing on the beds. In the test plots, weeds were almost nonexistent even though there was more than adequate moisture. This can be evidenced by the slides that accompany this report. In the test plot that contained the lumber cloth, one section was purposely left with no cloth underneath the sand. That area allowed the grasses and sedges to protrude through the sand, thus having the potential to compete with cranberry vines for moisture and nutrients. The area covered with cloth is devoid of any grasses. In one area that had been partially

prepared a year earlier, the story was different. In this bed we found a multitude of grasses, sedges, rushes, and broadleaf weeds. As these plants grew we pressed them for future identification. Because of this unusually hot and dry summer and having planted the vines late, 1994 may present many more unwanted weeds in the test plots. It is noteworthy that although some of the vines obtained in Massachusetts contained dodder, wild bean, and sedges, we did not see any evidence of these weeds growing in the test plots.

The month of July I termed "futility". Watering the vines diligently, I kept looking for growth. The little green leaves were in existence; the woody runners were green under the bark; yet nothing seemed to "explode" in growth. The vines just sat there doing nothing. This was true of all species planted, both natives and hybrids.

After five weeks we started to fertilize with a hand spreader. The vines that had been obtained in Mass. didn't grow well, however, the variety Crowley that had been obtained from cuttings that came from the Cape (from a different bog) started to "take off." The Crowley bed developed few runners, and produced only uprights from 2" to 5" in length. In discussing the phenomenon of non growth with visitors from Mass. who were in the business of growing cranberries, and who had visited the beds, it was suggested that the lateness of planting, and the dry summer stressed the plants to the point of not growing. Upon further analyzation, it was felt that the long test plots had more than adequate moisture to achieve growth. During the fall and winter we continued to question "why" and we were able to enlist the help of two growers from Mass. to try to ascertain why the vines had not grown. Those growers, well respected and with high yearly yields, suggested that the vines that we had purchased in Mass. had been treated with Casoron, a root inhibiting chemical used for weed control. This root inhibitor would create a situation for non growth or very retarded growth of the newly planted vines.

In October of '93 we removed some of the vines that had been planted. There was on the topical ends a small amount of new growth (less than an inch long) with greenish purple leaves . The root system was composed of many white fibrous roots, 1-3 inches in length with no branching side shoots. The vines were alive, and had by the end of the summer established a large enough root system which I hope will sustain them through the winter.

WINTER FLOODING

In December we initiated the "winter flood". Two of the test plots were covered with water, one was covered with straw, and the fourth was left open to the winter to

ascertain how much winter injury might occur. On the basis of weather forecasts stating that this might be the second coldest January since records were kept, it should be presumed that there will be considerable winter injury with chill factors of -40° to -60° Fahrenheit. The winter flood has allowed very little change in temperature on the test plots. The temperature has been consistantly averaging 28° - 33° F.

OTHER FUTURE RESEARCH

In preparing two commercial beds and a water reservoir in 1992. Lynch Hill Farms Inc. had planted field clover on the slopes of their irrigation pond. The object was to entice, prior to blossom time of cranberries, native bumble bees and other natural pollinators to be near the beds. Current research indicates that bumble bees visit approximately 14 flowers per minute as opposed to the commercial Italian honey bee which visits on the average 8.8 flowers per minute. In theory if one cranberry bed composed of 1 acre and having approximately 32 million flowers, it would only take 1200 bumble bees working 9-5 less than four days to pollinate the one acre completely.

The native Vaccinium leaf cutter bee, Osmia atriventris, also has some potential for cranberry pollination. This is another mini project we will undertake this coming summer. The native Vaccinium leaf cutter bee is the most efficient of all pollinators for the pollination of both cranberries as well as blueberries. Currently there is some research being done at the University of Maine concerning these bees, but as of yet they have not been able to trap enough of these bees in one season to sustain a population of leaf cutter bees large enough to be used as a commercial pollinator. We plan to set enough traps (actually nesting areas) around our beds to attract these insects to nest. I feel that we may have a better chance of building a population because of the proximity of the blueberry land to the cranberry bogs. This fact allows the insects a food source in the same location all through their flight that ends just after the cranberry pollination season is completed.

OBSERVATIONS OF OTHER COMMERCIAL BOGS

During the last few years I have had the opportunity to visit many commercial bogs around the Washington County area. I have noticed that many of the bogs are poorly constructed, i.e. out of grade, and some are constructed in areas that do not exhibit a source of water large enough for the management of a commercial cranberry venture. For many of the bogs that I have visited I hold little hope for their survival. However there are some bogs that I have visited that are constructed reasonably well and that could

maintain a viable environment for cranberry production given the correct care. One of the problems that has been encountered by the various farmers is the washing out of the berms in the spring. In Mass. many people use corrugated culverts cut in half with boards in them to act as a flume way and to control the level of the water on the beds. These do not work in the State of Maine! The frost in the ground during the spring thaw has picked up every one that has been used to date, and the berms wash out, sometimes placing its sediment on the bog below the berm, and ruining two beds instead of just one! With our beds, we used 8' x 3' cement pipes instead of corrugated culverts. We cut a hole in these pipes, and cemented a 6" ductile iron pipe through the wall of the large cement pipe. On the end of this iron pipe we installed a 6" gate valve for control of the water level on the bog.

I must stress the importance of having the bog completely level. Many bogs I have visited are far from an ideal grade. If a low spot in the bog occurs, the fertilizers and chemicals collect in these low spots, and they will be a curse forever. I hope that more people in the state that start into the cranberry business begin to realize this fact.

Weeds are a major problem that the bogs around the area I have visited are experiencing. Partially because the bogs are not being properly wed. Two major plants that are giving some farmers problems are cud grass, and marsh water cress.
These weeds would not be a problem however with proper weeding.

I also had the opportunity to visit a series of bogs that were planted on a harvested peat bog as a reclamation project. The plants on the peat-bog seemed to do very well, but there was one major flaw in the construction of the beds. There was no irrigation on the bog. The bog was very dry and the peatmoss was cracked just like a desert. The vines on the bog were two years old and the winter injury from the previous year's winter was tremendous. On this bog, there was no way that it could be flooded because the berms would turn to a slurry when saturated with water. This will be an interesting bog to watch in the future.

Overall the bogs in the Washington County area range from one extreme to another. Some will surely fold, but as with all farming some will manage to get by and produce a viable industry for Maine.

MEETINGS ATTENDED

During this last year there were a number of meetings held to help growers become more acclimated to growing cranberries. I attended a June 19th workshop on site in Jonesboro, Maine and attended a two day cranberry school at the Cranberry Experimental

Station at East Warem Massachusetts on January 11 and 12. Beginning in 1994, a cranberry committee was formed to help growers cope with regulations, rules, restrictions, etc. There have been two meetings January 18, and February 1, 1994.

In addition to these meetings, I have been in contact with Dave Yarborough, weed specialist, of the University of Maine at Orono Extension Service, and Warren Hedstrom, Professor in the Department of Bio-Resource Engineering.

Dave Yarborough, as a participating member of the Cranberry Committee of the R.C. and D., is working on a series of 8 programs early this spring to be held on existing cranberry sites here in Washington County. Some of these workshops will be conducted on site at the test plots that I have constructed. These sessions will include expertise from both Massachusetts, and Wisconsin. This will provide the opportunity to present my findings to as large a group as possible. The tentative program as of Feb. 1, 1994 include the following topics.

1. Bog construction and erosion /sedimentation control.
2. Frost control, drought and irrigation (Erving DeMaranuell, Mass.)
3. Hybrid varieties
4. The Cranberry Generalist (Roper of Wisconsin)
5. Integrated Pest Management (Hillary Sandler, Mass.)
6. Nutrition (Carolyn Demoranville, Mass.)
7. Weeds (Mary Jane Else, Mass.)
8. Cranberry Fungi (Dr. Frank Caruso, Mass.)

PRIMARY OBJECTIVES

In summary, the original project consisted of three primary objectives.

1. To determine which variety or varieties of cranberries that would be best suited to an eastern Maine climate.
2. To determine the different types and quantities of unwanted weeds / vegetation in the two growing environments.
3. To analyze the irrigation / water requirements of the planted cranberries in the two environments, and to project cost savings, if any, of reduced watering.

OBJECTIVE #1

In regards to objective #1, concerning the varieties of cranberries best suited to our climate, I could not determine this because of two criteria. The first criterion was the unusual weather conditions, and the harsh growing season that we experienced in the summer of 1993. The second criteria, and probably the most important, was the nature of the project. The portion of this study that deals with what variety of cranberry will produce the best in the State of Maine is not dependent on vegetative growth, but the production records of these different varieties over a period of many years. Do to this aspect of the project, it will be a few years before we have any concrete scientific evidence that establishes which variety is most suitable to our environment. In the Growers Guide of cranberry agriculture in Maine, the authors, Yarborough, Hedstrom, and Harker discussed what they consider might be possible varieties that would do well. The varieties that they include in this guide are Stevens, Howes, Ben Lear, and the Crowley variety. It should be noted that these four cultivars are presented by the authors, but there was no formal recommendation given by the authors as to the use of these cultivars. Essentially the authors were guessing, and had no scientific evidence that these varieties would do any better in the State of Maine than any other variety not mentioned in the growers guide. In reviewing these four cultivars, and in discussing the different varieties with experienced growers in Mass., we found that this may not be the case. In Massachusetts 97% of the cranberries that are produced in Massachusetts, are composed of two varieties. These two varieties are Howes, and Early Blacks. However, in the Maine Cranberry Growers Guide in Table 1.1, which lists principal cranberry varieties, no mention is made of the Early Blacks cultivar.

If one looks at the similarity of climates between Maine and Wisconsin, it should be noted that the varieties Searles, and MacFarlin constitute 85% of Wisconsin's acreage. Once again, no mention is made in Table 1.1 of the Growers Guide of principal cranberry varieties of these two varieties.

Some farmers in our area planted Crowleys this past spring. The Crowley variety is the main cultivar of the Washington State cranberry producers. However, the variety was not recommended highly by both growers, and researchers from the Cranberry Experimental Station in East Warem Mass.. It was found that this variety was very susceptible to fruit rot, and also that the variety cropped very well one year, but production dropped off substantially in the second year of production, followed by a larger crop in the third year. It seems that this cycle continues in the Crowley variety as long as the vines are in production. This fact coupled with the susceptibility to fruit rot leads me to the conclusion that for our new industry, the widespread use of the Crowley variety should not be recommended.

In the case of the Ben Lear variety, according to the research in Mass, this variety takes much longer to establish itself, requires a substantially larger quantity of water, and is less tolerable to some chemicals used in the production of cranberries.

Another factor that must be considered when selecting varieties is the time of berry ripening. Different cultivars ripen more quickly than others during the fall. The four varieties that are mentioned in the Growers guide in table 1.1 have ripening seasons that are listed as follows;

Stevens	mid season
Howes	late season
Ben Lear	early season
Crowley	early-midseason

Once again, no mention is made of the predominant cultivars in Massachusetts or Wisconsin with the exception of the Howes which have a late ripening berry. Because of this fact, one might question the feasibility of using the Howes variety in our climate due to our shorter growing season.

Another concern that should be raised is the vulnerability of the various cultivars to disease and pests. The old saying "do not put all your eggs in one basket," has some far reaching implications for Maine cranberry growers. Perhaps it would be best if a farmer, operating and managing four contiguous beds, could plant two different varieties, just in case one appears to be more resistant to a specific problem than the other. In the State of Wisconsin, one of their major problems is what is termed "Cottonball". This is caused by a fungus closely related to "Mummy Berry" which at the present time affects blueberry production in Maine. Since we live in close proximity to vast acreages of wild blueberry production areas, it is anticipated that this will probably become of concern to Maine cranberry growers in the future.

As mentioned very early in this report, there appears to be more questions than answers in determining which variety of cranberries is most suitable to our climate, and is going to be a very long and tedious process.

OBJECTIVE #2

The second objective of determining the types and quantities of weeds also was subject to the extreme weather conditions. On the beds that were analyzed, the native weeds that were found included the following:

Trailing Blackberry

Bent grass

Whorled loosestrife
Assorted asters
Assorted sedges
Beggars ticks
Panicum grasses
Poison Ivy (Possibly native, but may have been imported with vines)
Brambles
Red maple
Golden rod
Virginia creeper

Other bogs around the area had many more species of weeds, probably due to inadequate weeding, and large populations of these weeds surrounding the bogs. Some of these other weeds that I have encountered have been Trembling aspen, cudweed, and yellow marsh cress. On the bogs that I observed that were planted on a peat environment, I found that there were fewer weeds, but that many rushes and hydrophilic grasses appeared to be a problem. The other major species of weed that grows very well on the peat is the poplar, or trembling aspen. None of the native plants that inhabit natural peat bogs grew in the beds, and I do not feel that they will impose any problems in the future.

The species of weeds that I mentioned earlier were present, but all populations were very low in our test plots. If there is one imperative rule for planting cranberries, it should be to visit the bog that the vines that you are buying are going to be harvested from. It is very important to look for serious problem weeds such as dodder, wild bean, brambles, etc. that are present in vines in vines that you buy. Perhaps finding vines totally free of unwanted weeds cannot be achieved, and if this is the case, close inspection of the vines from the bulk pile to the pickup or cart while planting should be undertaken. While Massachusetts history indicates 37 problem weeds in their beds, our experience to date shows approximately one half of that number. If we are careful in the purchase of vines and not rush to the market where unscrupulous dealers will sell anything, we have the opportunity to build not only on the successes of Massachusetts, but also thwart the failures that they have experienced in the past.

OBJECTIVE #3

In objective three, where an attempt was made to analyze water requirements of the different environments, once again weather extremes played a significant role in trying

to pin down requirements and costs. I used the traditional spacing of 50' x 60' or 50' x 50' with the Rainbird #30h sprinkler heads. There have been questions raised in the last year as to the uniformity of the spray of the heads. It appears that more of the water is applied to the outer perimeter of the circle than is applied at the midpoint region. An alternative possibility might be the introduction of a 40' x 50' spacing pattern using a Rainbird #30 PWSH sprinkler which is also composed of brass, but has an anodized aluminum arm. This allows for a faster head rotation, which may give a more uniform coverage of the bog. The #30 PWSH runs at a lower pressure (40 pounds) than the #30h, which runs at 60 pounds. There is also a projected water savings of 11% over the Rainbird 30h. This equates to a 1104 gallon reduction in water use per head in an 8 hour frost night's water usage, a sizable saving in both fuel costs, and also the cost of pump maintenance.

Irrigation requirements in a peat environment represent another challenge to the prospective growers. In attempting to establish beds on peat, or on abandon peat bogs previously mined for dry peat, there appears to be no happy medium. Cranberries require a large amount of water for growth, yet at the same time to much water creates an environment that fosters fungal disease. Having monitored other beds planted on peat, I noticed large drought cracks in the peat soil due to the extreme weather conditions this past summer. Those cracks, some in excess of one inch wide and several feet in length, must have retarded growth since the roots of the cranberries were exposed to open air. A second factor in analyzing the peat environment is the protection of uprights from the winter injury and frost upheaval. Flooding in the peat environment represents a challenge for which there are no easy answers but left to the open winter these vines are very susceptible to die back.

In one bed, where we attempted to analyze the effect of deeper sand we had both failure and success. We planted both Howes, and some native vines in a bed where we used at least 8" of sand, and in some portions of the bed there was more than 8" of sand. The 8" of sand was applied per the recommendation of the Maine Cranberry Growers Guide on page B-11. Both of these varieties did very poorly, with the loss of over 75% of these two varieties. Because of the nature of the shallow root system, and because these vines were depressed 2-3 inches into the sand. It is my feeling that most of the water permeated below the level of the root system of the newly established plants. Due to this lack of water and the daily evapotransporation of the plants, these plants were stressed significantly. It would be my recommendation that no more than four inches be places on a new bog for planting purposes. I have been told by experienced growers in Mass., that when they plant their bogs, they use only 2" of sand, and I have also heard accounts of using only 1" of sand.

As I stated in the beginning of this report, I have over the course of this project found more questions than answers. Although this portion of the work has been completed I plan to continue my endeavors in the cranberry industry to help find some concrete data to help farmers in Maine with their problems in the cranberry industry. I thank you for this opportunity and for your help in starting this long-term project.