WINTERKILL PATTERNS OF FORAGE CROPS AND WINTER WHEAT IN P.E.I. IN 1972[1]

Michio Suzuki[2]

Abstract

Prolonged subfreezing soil temperatures during the winter months of 1972 resulted in one of the most severe plant winterkills in the history of Prince Edward Island. Red clover (Trifolium pratense) sustained the greatest loss, followed by alfalfa (Medicago sativa), winter wheat (Trifolium aestivum), and orchardgrass (Dactylis glomerata). Birdsfoot trefoil (Lotus corniculatus) and bromeqrass (Bromus inermis) sustained less damage. The hardiest crop was timothy (Phleum pratense) but even this crop did not escape damage. The lethal damage to individual crop species occurred at different times. Red clover plants were killed in February or earlier, orchardgrass in April, and birdsfoot trefoil in May. Winter wheat and bromegrass lost vitality gradually throuqhout the winter and were dead by spring. Despite the severe winter conditions, very few cases of plant damage caused by frost–heaving were observed.

Climatic conditions

Air temperature at Charlottetown, Prince Edward Island during the winter months of 1972 was slightly below the average for the past 63 years (Fig. 1), but the soil temperature was much below the average for the past 12 years (Fig. 2). The low soil temperature resulted from the abnormally high rainfall during January and the first two weeks of February with 52% and 86%, respectively, of the total precipitation falling as rain during these periods. The resulting absence or lightness of snow cover meant that many areas of P.E.I. were exposed to cold air temperatures or were covered with ice sheets. On February 9 the soil temperature reached record lows of −12.8, −8.9, −6.7, 0 and +2.2 C at depths of 5, 10, 20, 50 and 100 cm, respectively, and the top 50 cm of soil remained frozen until May, being subject to occasional alternate freezing and thawing in March and April. Under these circumstances, one of the most severe winterkills in the history of P.E.I. occurred in 1972.

Extent of damage

Surveys were conducted in June to determine the extent of damage to forage legumes, grasses, and winter wheat. The number of surviving and dead plants was counted with each of ten 1 ft^2 areas chosen at random in each field, and the percent survival for individual crops was estimated at various locations of P.E.I.

Damage to red clover (Trifolium pratense L.) and alfalfa (Medicago sativa L.) was great in most areas except in a few fields situated close to coastal waters. Birdsfoot trefoil (Lotus corniculatus L.) was damaged to a lesser extent. It was noted that damage to the legumes grown in mixtures with grasses, particularly those protected by oat stubble or other companion crop, was much less than in pure stands of legumes.

Among grass species, timothy (Phleum pratense L.) was the hardiest, while orchardgrass (Dactylis glomerata L.) and winter wheat (Triticum aestivum L.) were severely damaged. Winterkill of bromegrass (Bromus inermis Leyss.) in poorly drained fields was also extensive.

There was also a great loss of strawberry plants, almost all mother plants being killed. Daughter plants survived in a few fields.

The extent of winterkill varied considerably, beinq dependent upon location, drainage conditions, soil type, plant species, cultivar, age, and management regime.

Winterkill patterns

In the spring, patches of winterkill with various sizes and shapes appeared in many fields. Almost all plant species within patches were either killed or severely injured, making the boundaries of each patch

---

[1] Contribution No. 268, Research Station, Canada Department of Agriculture, Charlottetown, P. E. I.

[2] Plant Physiologist.

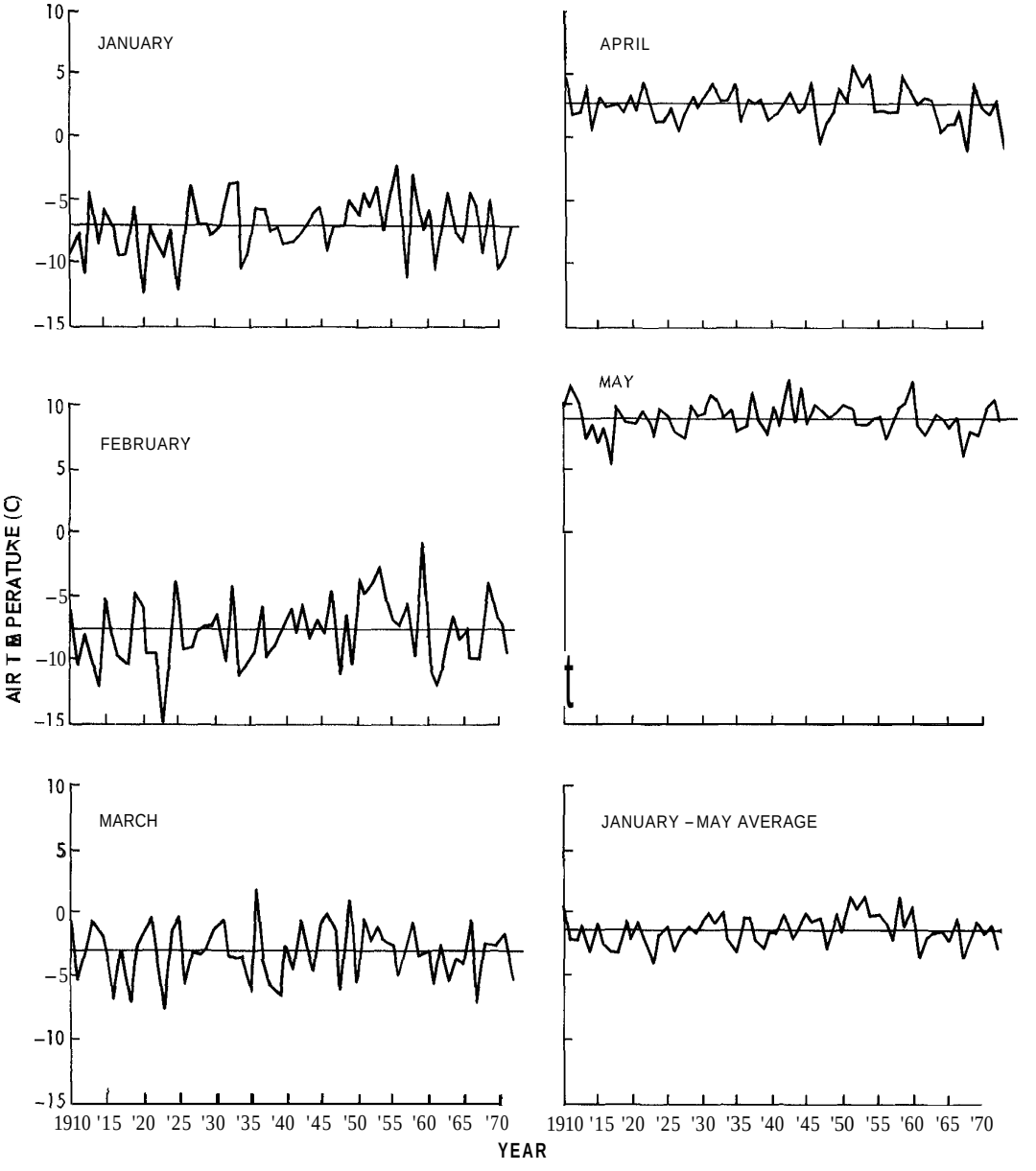

Figure 1. Monthly averages of air temperature at Charlottetown, P.E.I., from 1910 to 1972. Straight lines indicate the 63–yr. averages.

distinct. Other winterkill patterns, such as partial or complete disappearance of legume stands from a grass–legume mixture, but without the formation of characteristic patches, which often occurred in the past, wefe observed all over P. E. I. There were, however, very few cases of winter injury due to frost–heaving, one of the major causes of winterkill in the past.

In order to determine the time of lethal damage to the individual crop species, with the exception of timothy, which had good survival, sample plants were dug out of the soil during the period from February 17 to May 26 and taken to a greenhouse. Sampling procedures were attended with the difficulties of reaching fields and of digging root systems from frozen soil. In the present survey, sampling was carried out, using pickaxes, at regular time intervals during the season in selected fields. The use of a tractor equipped with a soil–core sampler for digging as well as a torch €or defrosting soils was unsuccessful. Further studies to develop and evaluate more

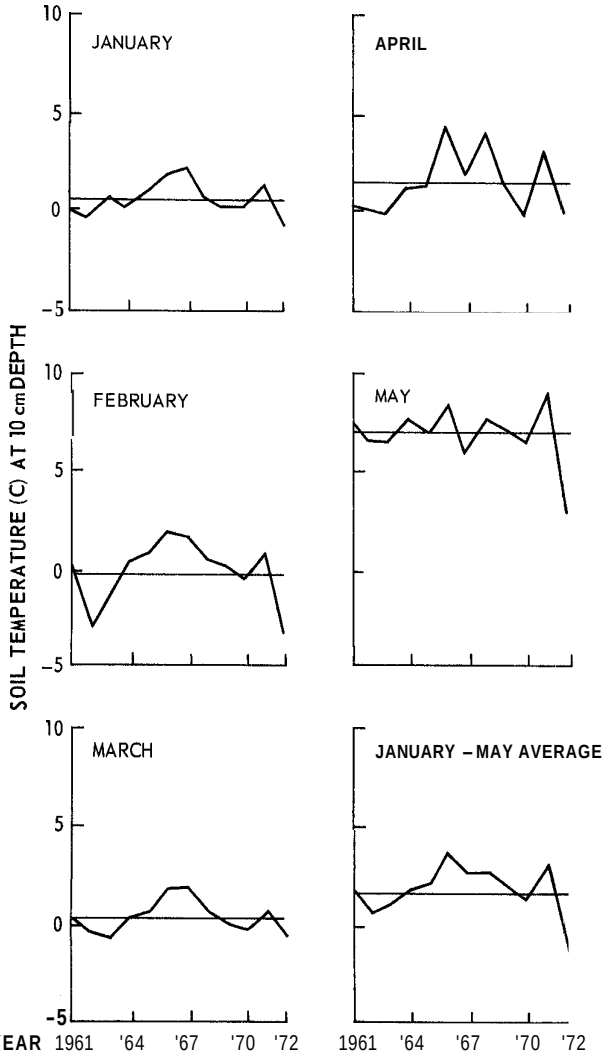

Figure 2. Monthly averages of soil temperature at Charlottetown, P.E.I., from 1961 to 1972. Straight lines indicate the 12–yr averages.

efficient equipment for the purpose are required.

The sample plants were grown in the greenhouse under day and night temperatures of 18C and 13C, respectively. Three weeks after transplanting, the number of surviving and dead plants was counted.

Since judgement of injury or death of plants in the field by means of visual observation was not reliable, the vitality of fresh sample plants was examined by staining crown and root tissues with triphenyltetrazolium chloride (TTC) (1). Staining degrees that reflect plant vitality were scored as 3, 2, and 1 for dark red, red, and pink color, respectively. A dead plant was not stained and was scored as 0 (Table 2). It was found that red clover plants were killed or severely injured in February or before. The tap roots of red clover sampled on February 17 were spongy and many of them were rotted. Alfalfa and birdsfoot trefoil plants that survived through February maintained high vitality of crown and root tissues until the third weed of March. Approximately 40% of the alfalfa plants observed in the fields started new top growth during the last week of April, but the root system became spongy, with several incidents of severe root rots, and failed to support the top in May. New shoots of birdsfoot trefoil did not appear above the ground until May, thus receiving less damage than alfalfa.

Orchardgrass was killed in April or earlier. Vitality of grass species in February and March was lower than that of alfalfa and birdsfoot trefoil, but bromegrass lived longer than these legumes. Winter wheat lost vitality gradually throughout the winter and was dead by June.

Table 1. Winter survival of forage legumes, grasses, and winter wheat in 1972

Crop	survival (%) Range	Mean	Plant age[1] (years)	Cultivar[2]	Pure stand or[3] mixture with	Location[4]	No. of fields observed
Alfalfa	0-42	22	1-4	Narragansett	Timothy	Q-S	6
				Saranac	Bromegrass	Ch	4
				Alfa	Pure	Q-N	2
				Iroquois	Orchard grass		
Birdsfoot trefoil	0-65	37	1-3	Leo	Timothy	Ch	4
				Empire	Pure		
				Viking			
Red clover	0-93	20	1-2	Lakeland	Timothy	Q-S	10
				Unidentified[5]	Pure	Q-N	8
						Ch	4
						K-N	4
						K-S	4
						P-S	4
						P-N	4
Timothy	72-93	83	1-5	Climax	Pure	Q-S	10
				Champ	Red clover	Q-N	8
				Unidentified[5]	Alfalfa	Ch	4
					Birdsfoot trefoil	K-N	4
						K-S	4
						P-S	4
						P-N	4
Bromegrass	15-88	71	1-3	Redpatch	Alfalfa	Ch	6
				Saratoga	Pure		
Orchard grass	0-52	26	1-2	Tardus II	Pure	Ch	3
				Erode	Alfalfa	Q-S	1
Winter wheat	0-36	24		Yorkstar		K-N	9
				Genesee		Ch	3
				Talbot			
				WW1001-1			

[1] One-year-old plants tended to be more susceptible, but not always

[2] Listed in the order of dominant cultivars in the fields, not including ones in variety trial plots.

[3] Listed in the order of more common practice in the field. Pure stands of legumes suffered most; there was little difference among components of mixtures.

[4] Ch within 5 miles of Charlottetown; K Kings County; Q Queens County except Ch; P Prince County; N North; S South

[5] Information was not available from the farmers, but fields were assumed to be planted mostly to a mixture of 'Climax' timothy and 'Lakeland' red clover.

Table 2. Vitality of field plants sampled during the winter and spring of 1972

crop		Sampling date: Feb. 17	March: Early	March: Late	April: Early	April: Late	May: Early	May: Late
Alfalfa	% survival[1]	94	98	72	47	26	0	0
	vitality[2]	2.8	2.8	1.8	1.6	1.5	0	0
Birdsfoot trefoil	% survival	93	96		75		26	0
	Vitality	2.4	2.0		2.0		1.6	0
Red clover	% survival	46	15	0				
	Vitality	1.7	0.9	0				
Brornegrass	% survival			91		78	72	
	Vitality			1.5		1.4	1.2	
Orchard grass	% survival		88		28		0	
	Vitality		1.9		0.9		0	
Winter wheat	% survival	85		71	69		44	32
	Vitality	1.8		1.2	1.2		1.1	0.9

[1] Percent survival of plants removed to the greenhouse.

[2] Vitality index (max. 3.0) for suviving plants = $\frac{3A + 2B + C}{A + B + C}$

where: A = number of very active plants stained dark red with triphenyltetrazolium chloride (TTC);
B = number of active plants stained red with TTC;
C = number of weak plants stained pink with TTC.