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A STUDY OF VEGETATIVE AND REPRODUCTIVE DEVELOPMENT IN CAUCASIAN CLOVER (*Trifolium ambiguum, M.Bieb.*) CV. MONARO

BY :

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NEW ZEALAND

1993

A STUDY OF VEGETATIVE AND REPRODUCTIVE DEVELOPMENT IN CAUCASIAN CLOVER

(*Trifolium ambiguum, M.Bieb.*) CV. MONARO

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of the requirements for the

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ABSTRACT

A STUDY OF VEGETATIVE AND REPRODUCTIVE DEVELOPMENT IN CAUCASIAN CLOVER (*Trifolium ambiguum, M.Bieb.*) CV. MONARO

(FAHAM EFENDI, 1993)

SUPERVISORS : 1. Dr. Peter Coolbear
2. Prof. Murray J. Hill

A four year established stand of Caucasian clover (*Trifolium ambiguum,M.Bieb*) cv. Monaro grown on Fine Sandy Loam with moderate fertility was studied to assess the vegetative and reproductive development and the effect of defoliation on seed yield and yield components from September 1991 to June 1992.

As in many other traditional herbage legumes, an indeterminate growth habit and a protracted flowering period can be a factor limiting seed production in this clover. From the examination of the vegetative growth and flowering behaviour, it was found that the protracted flowering pattern in this clover is mainly caused by continuous production of reproductive shoots from the crowns rather than continuing inflorescence emergence in one stem as results indicated that inflorescences produced were mainly associated with the number of reproductive shoots available at the time of inflorescence emergence.

Reproductive growth commenced at the beginning of October when most visible inflorescence buds were formed and subsequent flowering occurred about 8 weeks later. This reproductive growth was found to be the most concentrated on reproductive shoots/stems formed in November to December 1991. These reproductive shoots contributed the majority (70%) of proportion to total inflorescences.

Inter-row cultivation decreased the number of reproductive shoots produced as well as decreasing the number of inflorescences at harvest. Inflorescences originating from main crowns produced a higher number of floret buds and seeds per inflorescence than those originating from secondary crowns as the main crowns have their own strong taproot system and are more mature. Throughout the flowering season, *T. ambiguum* consistently abort about 10 % flower buds before the flowers open. On average of 60% of the open florets developed into live pods at maturity, but only one from two ovules in an ovary usually developed into seeds. On average of about 72% of pods had one seed, 11% of pods with two seeds and 16% were without seed.

Both in early and middle flowers, seed development studies revealed that maximum yield of high quality seed was obtained only when seeds attained their maximum dry weight at 30 days after pollination, at the time when seed moisture content had fallen to 30 to 40%. At this time the pods were yellowish brown in colour. To ensure the production of good quality seed with high yield in *T. ambiguum* it is necessary, therefore to wait crop until at least 34 days after pollination for harvesting the seeds. Seeds harvested early at day 14 to 22 did not retain their viability suggesting that these seeds was still immature and could not withstand desiccation. It was found that pod shattering begun at about 8 days after maximum dry weight (mass maturity) was reached. Heavy rainfall and strong dry wind was found to enhance the rate of shattering. Hardseededness was observed firstly in freshly harvested seeds when seed moisture contents were close to 20%. The levels of hardseededness was higher after drying. Inflorescences set later in the season produced more hard seeds due to higher temperatures and increased humidity during maturation stage.

The results of this experiment have confirmed the high seeding potential of *T. ambiguum* (cv. Monaro) and this should facilitate the production of adequate seed supplies of this cultivars. The average seed yield potential, potential harvestable seed yield and actual seed yield was 893 kg/ha, 707 kg/ha and 427 kg/ha respectively. This might be attributed to the facts that the crop examined in this study was a four year established sward which was mature enough to produced a high yield.

Another study was done involving late defoliation treatments designed to investigate their possible effects on plant growth and seed production. Cutting the plant to the ground level showed an obvious harmful effects on seed yield in *T. ambiguum*. The results show that October and November cutting resulted a 67 and 72% decrease in actual seed yield compared to uncut control. This results support Steiner's view (**in press**) that the plant morphology of *T. ambiguum* limits its ability to recover from defoliation.

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Bismillahirrahmaanirrahiim
In the nama of Alloh the most gracious and merciful

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CHAPTER 1

GENERAL INTRODUCTION

1.1. General description

Caucasian clover (*Trifolium ambiguum, M.Bieb.*) which is also well known as Kura, Honey or Pellet clover in the USA is a rhizomatous perennial legume with a potentially wide range of adaptation throughout high mountain environments in the middle latitudes including cold, temperate and intermontane areas, as well as continental rangeland and steppes (Bryant, 1974). It is believed that the plant is indigenous to the Caucasian region of the USSR, Eastern Turkey and Northern Iran (Zohary, 1970) where it is utilised for hay and as a pasture legume (Hely, 1957; Komarov, 1945). Literature on this clover is limited and has been concisely reviewed by Bryant (1974).

Caucasian clover has received considerable attention for agricultural purposes in USSR, Czechoslovakia, Canada, USA and in Australia. Agronomic evaluation in New Zealand has shown that *Trifolium ambiguum* cv. Summit (Paljor, 1973), cv. Treeline (Stewart, 1979) and cv. Monaro (Gurung, 1991) exhibit several characteristics which identify it as promising plant for eroded slopes as well as valuable pasture clover for high country environments.

1.2. Agronomic potential and agricultural value

The potential of this clover as an important alternative pasture plant is clear because of its early seasonal production, persistence under heavy seasonal grazing,

its vigorous rhizome development, and its adaptability to grow and persist on low pH (<5) soil where other clovers (*e.g. Trifolium repens*) fail (Agabayan, 1960; Bryant, 1974).

Following its introduction in the USA in 1911, Pellet (1946) reported the following advantages of this clover: firstly, once established, it provides highly productive and long-lived permanent pasture for hay, forage and silage; secondly, it is profuse flowering with nectar readily available; thirdly, its habit of spreading from underground rhizomes ensures an increase in the stand; and lastly, its extensive root system which makes it a good proposition for oversowing in highly eroded sites for soil conservation. In addition, it is a long-lived perennial plant which is deep rooting, drought resistant and winter hardy (Komarov, 1945).

In New Zealand, clovers play an essential role as a forage pasture in most farming systems. However, under the harsh conditions of New Zealand hill and high country, there are only a few pasture species which are able to persist and make a significant contribution to pastures (Scott *et al.,* 1983). Under low fertility, low pH, low winter temperature and seasonal moisture deficit, the growth of traditional legumes such as *Trifolium subterraneum, Trifolium repens* and Lotus corniculatus are restricted (Chapman and Macfarlane, 1985; Scott *et al.,* 1983). With the demand to develop alternative productive pastures under marginally productive areas, therefore, the potential uses of caucasian clover as a forage legume have become recognized.

Caucasian clover is also resistant to many of the viruses common to other temperate clovers (Burnett and Gibson, 1975; Jones *et al.,* 1981). Stewart (1979) observed that *Trifolium ambiguum* persisted in an area which was heavily infested

with grassgrub (*Costelytra zealandica*) where both *Trifolium repens* and *Trifolium hybridum* were killed. *Trifolium ambiguum* was reported to be a host for the clover cyst nematode (*Heterodera trifolii*), but it was demonstrated to be much more resistant to it than *Trifolium repens* (Norton and Iselly, 1967).

This clover compares favourably in feeding value with other traditional legumes (Speer and Allinson, 1985). Its acceptability to all form of livestock (Pellet, 1945; Larin 1956), its non-oestrogenic nature (Anonymous, 1977), its high concentration of nitrogen and minerals, and its digestibility (FitzGerald, 1980; Davis, 1981; Allinson *et al.*, 1983) are some valuable characters which make this clover superior to other traditional legumes in many circumstances.

1.3. General agronomic and management problems

Despite its promising characteristics, however, this clover has not been developed commercially and has found only limited used outside its indigenous habitat (Townsend, 1970; Hely, 1971). This clover is difficult to establish because of slow seedling growth and no work appears to have been specifically directed toward determining the growth pattern of this clover.

As in other newly introduced legumes, the difficulty in achieving a substantial amount of high seed yield is frequently reported as a major factor limiting its more widespread use in pasture systems. Because of slow growth, or perhaps other reasons, seed yields the first year after planting are as low as 70 kg per hectare. Seed yields in later years are reported to range from 100 - 600 kg per hectare (Bryant, 1974; Voloshenko *et al.*, 1979; Stewart and Daly, 1980; Steiner, **in press**). It has been suggested that characteristics contributing to its low and unreliable seed

yield include poor pollination, erratic and protracted flowering, and poor seed set (Hampton *et al.,* 1990). Above all, there is little information available on suitable agronomic management practices for both herbage and seed production.

1.4. Objectives of the study

This study was conducted as a result of the demand for a better understanding of this clover and the need for the development of appropriate management strategies to improve seed production. The objectives of this study are :

1. To define the morphological characteristics of *Trifolium ambiguum, M.Bieb.* during regrowth periods
2. To determine potential seed yield, and to examine possible causes of low seed yield in field conditions.
3. To describe in detail the sequence of seed development which can be used to determine optimum harvest time.
4. To determine the response of aerial and underground plant components to different times of defoliation and to identify some of the effects of defoliation on reproductive growth and seed yield.

This study was carried out in one growing season on a four year old established stand of *Trifolium ambiguum* from September 1991 to July 1992 on the AgResearch Grasslands Research Unit, Aorangi, Palmerston North, New Zealand.