1. INTRODUCTION

An ever growing population and escalating input costs have enforced farmers to harvest maximum from their farmlands. At the same time they must have to adopt economically viable cropping systems to survive. Among various cropping systems prevalent in north India, maize-wheat is most popular particularly in hilly rainfed areas. Both, maize and wheat are heavy feeders, and exhaust the soil nutrients to the maximum. This turns the soil depleted for succeeding crop. The depletion of nutrient stocks in soil is often a hidden form of land degradation which requires improvement in plant nutrient management. In fact, soil nutrient supply is improved when crops with relatively high nutrient demands are rotated with crops leaving relatively high amount of residues containing substantial amount of nutrients. Soybean is one crop, which builds up the soil fertility by atmospheric nitrogen fixation through the root nodules and also through leaves falling on the ground at maturity. It leaves residual nitrogen equivalent to 35 to 40 kg per hectare for the succeeding crop (Chandel et al., 1989). Soybean has the ability to perform well under a wide range of soil types and planting dates. The symbiotic relationship between soybean and rhizobium reduces production costs and makes soybean a good rotational crop for use with high nitrogen-consuming crops (Varvel and Peterson 1992). This new cropping system provides them that tool.

Soybean-wheat cropping system has a great potential in the northern plains of India. With many problems in the traditional rice-wheat (Verma and Sharma, 2007) or maize-wheat cropping systems, the soybean-wheat has emerged as a good alternative both for crop diversification as well as for maintaining the sustainable soil health. However, both these crops require better nutrient, water and weed management practices to express their full potential.

Besides residual effect on soil fertility, soybean has great potential as an exceptionally nutritive and very rich protein food. It can supply the much needed protein to human diets. It contains above 40 per cent protein of superior quality with all the essential amino acids particularly glycine, tryptophan and lysine,
similar to cow’s milk and animal proteins. Soybean also contains about 20 percent oil with an important fatty acid, lecithin and Vitamin A and D. The 4 percent mineral salts of soybeans are fairly rich in phosphorous and calcium. It grows in varied agro-climatic conditions, thus emerged as one of the important commercial crop in many countries. Although, a native of China, soybean for all practical reasons is an American crop today. USA is the major producer of soybean and ranks first in production. It’s share in the world production is almost 35 percent. Brazil, Argentina and China rank second, third and fourth respectively, in terms of production. India occupies fifth place.

In India, soybean was introduced from China probably through Himalayan route or through Mayanmar. The cultivation of black seeded soybean started as early as in 1882 at Nagpur. It is the member of family Leguminoseae and sub family Papilionoideae. This crop has rightly been named as a miracle crop of 20th century. Soybean ranked first in world as a source of vegetable oil. Soybean oil is consumed, as salad oil, vegetable shortening and margarine. The oil is used for frozen desserts, cookie shortening, confection, icing, ice cream coating, whipped topping and coffee whiteners. Industrial uses of oil are in soaps, paints, resin and dry oil. A number of protein rich products, soy milk, soy cheese (paneer), soy sauce and soy flour are also produced from seeds.

In India, it is cultivated in an area of 9.3 million hectare with an annual production of 10.47 million tonnes and average productivity of 1120 kg ha\(^{-1}\) (Anonymous, 2010). In Himachal Pradesh, it is cultivated on 0.6 thousand hectares with a production of 0.8 thousand tonnes and average productivity of 1333 kg ha\(^{-1}\) (FAI, 2007). Although the average productivity of soybean in Himachal Pradesh is higher than the national average due to favourable conditions for its growth and development, yet the productivity is much below the potential level of 3000 kg ha\(^{-1}\). Among the various factors of low productivity of soybean, competition by weeds is the major one. Being a rainy season crop, it is invaded by a wide variety of weed flora in different flushes which compete with the crop plants for nutrients, light and moisture apart from their allelopathic effects. Weeds have been reported to reduce soybean seed yield by 20 to 77 per
cent (Kurchania, et al., 2001) depending upon nature, intensity and duration of weed species present in the field. Weeds increase cost of cultivation and deplete resource base (Buriro et al., 2003). In order to achieve enhanced crop production and higher benefits from applied inputs, weeds must be kept under check using any of the safe and effective weed control measures.

The presently recommended pre-emergence herbicides are either having narrow spectrum of weed control or less effective against different flushes of broad-leaved weeds. Moreover, in case the pre-emergence application of herbicides is missed due to one or other reasons, alternative post emergent herbicides for controlling weeds in soybean are required to be investigated. Therefore, there was an urgent need to find out effective post emergence herbicides alone or in combination having broad spectrum of activity and longer persistence for control of weeds in soybean-wheat cropping system. In the present study, some new pre and post emergence herbicides viz. imazethapyr, quizalofop-ethyl and chlorimuron-ethyl alone and in combinations were tested for effective weed management in soybean and their residual effect on wheat with the following objectives :-

I. To study the bio-efficacy of different herbicides to manage weeds and their effect on growth, development, productivity and quality of soybean,

II. to study the residual effect of herbicides on weeds and growth, development and productivity of succeeding wheat crop; and

III. to study the relative economics of different treatments in soybean and soybean-wheat sequence.