3.7 Weed index (WI)

The weed index clearly reflected the effectiveness of different weed management practices in reducing yield losses. The highest weed index (64.41%) was recorded in the weedy check, indicating severe yield reduction due to weeds. Negative weed index values observed under bispyribac sodium (−3.39%) and bispyribac sodium + 2,4-D (−1.69%) indicate slightly higher yields than the weed-free treatment, possibly due to reduced crop disturbance and better resource use efficiency under chemical control. Higher weed index values in pendimethalin + 2,4-D and pendimethalin alone treatments suggest comparatively lower weed control efficiency, especially against later-emerging weeds.

4 Discussion

4.1 Vegetative growth and biomass

Plant height, dry matter production, and CGR were greater under the more effective weed-management treatments than under the weedy check, especially during the later growth stages. The temporal pattern of CGR, with an increase toward 60-75 DAS followed by a decline during 75-90 DAS, is consistent with the changing balance between vegetative biomass accumulation and reproductive development. The present experiment did not measure weed density, weed biomass, nutrient uptake, or photosynthetic traits. Therefore, the greater growth observed under bispyribac sodium treatments may be associated with reduced crop-weed interference, but the mechanism was not directly demonstrated. Previous DSR research has similarly linked timely weed suppression with improved crop growth, although responses depend on weed spectrum, environment, and application timing (Chauhan and Johnson, 2011; Mahajan et al., 2014; Shekhawat et al., 2020).

4.2 Yield components

Bispyribac sodium and bispyribac sodium + 2,4-D produced the greatest effective-tiller and filled-grain means, and both treatments were statistically grouped together. Their lower sterility values were also numerically favorable, although all weed-management treatments were statistically grouped for sterility and unfilled grains. This pattern suggests that maintaining crop growth during tillering and reproductive development may partly reflect improved yield-component formation, but the study did not directly measure the physiological processes responsible. The response is directionally similar to reports from DSR systems in Nepal and South Asia, where timely weed-management treatments improved tiller formation and grain filling (Dangol et al., 2020; Poudel et al., 2020; Sharma et al., 2021). Direct comparison of response magnitude should nevertheless be made cautiously because the cited studies differed in location, variety, weed flora, and treatment schedule.

4.3 Grain yield and biomass partitioning

The most important result was that bispyribac sodium alone and bispyribac sodium + 2,4-D produced statistically similar grain yields, 6.1 and 6.0 t/ha, respectively. The weed-free treatment also belonged to the same statistical group at 5.9 t/ha. Thus, the data do not support the claim that adding 2,4-D increased grain yield over bispyribac sodium alone. The single-herbicide treatment may be operationally simpler and uses fewer active ingredients, whereas the combination could be considered only where the weed spectrum, label requirements, compatibility, and resistance-management strategy justify it. Because treatment costs and returns were not measured, no economic advantage can be assigned to either option. The greater straw yield and harvest index under effective treatments indicate improved total biomass production and partitioning, but these interpretations are based on yield measurements rather than direct measurements of assimilate allocation.

4.4 Weed-management implications

Under the conditions of this experiment, bispyribac sodium alone and bispyribac sodium + 2,4-D were the most promising treatments for grain yield and several yield attributes. However, a weed index based on grain yield does not replace direct measurements of weed density, species composition, or weed biomass. The negative weed-index values for the two bispyribac sodium treatments indicate that their numerical yields exceeded the weed-free treatment, but they do not by themselves demonstrate broader weed-spectrum control or long-term