Lessons from the Field:

Crop Challenges in the Arid Northern Cape Region

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The Northern Cape is one of South Africa's driest provinces, with an average annual rainfall of less than 200 mm in many areas. Despite the harsh environment, vegetable farming plays a critical role in ensuring regional food security and supporting smallholder livelihoods. As climate change brings more unpredictable weather patterns such as intense heatwaves, erratic rainfall, and prolonged droughts, the ability to grow crops under such conditions is becoming more challenging. The Agricultural Research Council (ARC), with funding from the Department of Agriculture, Land Reform and Rural Development (DALRRD), launched an important initiative in October 2024 to assess the impact of climate change on vegetable production. The aim is to develop practical

Research trials implemented by the Agricultural Research Council on a smallholder vegetable farm located in the ZF Mgcawu District Municipality, Northern Cape Province

Larvae (left) and adult phases (right) of African bollworm (Helicoverpa armigera).

recommendations for farmers, especially under arid climatic conditions, including suitable alternative production areas. Our research and development efforts were implemented on a smallholder vegetable farm in the ZF Mgcawu District Municipality, Northern Cape Province. The trial involved eight high-value vegetable crops (beetroot, carrot, lettuce, onion, spinach, cucumber, tomato, and pepper), which were chosen for their high nutritional content, market value and potential adaptability to warm, arid climatic conditions. However, as with any fieldwork in challenging climates, we encountered several obstacles that brought valuable learning opportunities especially around pest management and plant spacing.

African Bollworm infestation across multiple fruity vegetable crops

A significant challenge during the trial was the unexpected outbreak of African bollworm (*Helicoverpa armigera*), which affected not only our cucumber crops but also tomatoes and chilli peppers. Although this pest typically targets crops like maize and cotton, it has a wide host range and can adapt to new environments and crop types particularly under changing climatic conditions. The larvae typically damage the fruit while the adult stage targets the leaves.

In our experiment, we have observed that the larvae bored into developing fruits, causing internal rotting and visible holes that rendered the produce unmarketable. In several instances, a single larva damaged multiple fruits, drastically reducing overall yield and market quality of the crop. The outbreak was likely worsened by high temperatures following an excessive period of rainfall. These environmental factors are known to speed up the Bollworm's life cycle and increase its reproductive rate. This highlighted the importance of routine pest scouting, not just for common pests but also for opportunistic ones that may emerge due to ecological shifts. Under changing climate conditions, pests can shift hosts or extend their range, making integrated pest management (IPM) more crucial.

Plant spacing issues: overcrowding from over-seeding or -transplanting

To increase the chances of seedling establishment in warm, dry climatic conditions, we opted to plant multiple seeds or seedlings per hole for crops such as carrot, spinach, beetroot and spring onion. This approach was intended as a hedge against poor germination rates often caused by high soil surface temperatures and rapid moisture loss. However, while the strategy improved initial emergence rates, it inadvertently led to severe overcrowding, with multiple seedlings competing for space, water, light, and nutrients. This experience emphasized that over-seeding can be counterproductive, especially if thinning is not done promptly. Thinning is often overlooked because it is labour-intensive and time-sensitive, especially

Damage caused by African Bollworm (Helicoverpa armigera) larvae on cucumber (left), chilli pepper (middle) and tomato fruits (right) at Groenvingers Vegetable Farm in the Northern Cape Province

on small farms with limited manpower. However, it remains one of the most cost-effective agronomic practices for ensuring uniform crop stands. Thinning should ideally be done when seedlings are 5–10 cm tall, and the removed plants can even be transplanted to fill gaps where there are missing plants, thus minimizing waste. This experiment demonstrated that proper spacing is critical for healthy crop development and optimal yields, particularly for root and leafy crops.

The consequences of over-seeding or -transplanting were visible across different study crops, including (a) carrots which became stunted and developed forked or twisted roots, (b) spinach which produced small, pale, fragile and crowded leaves, (c) beetroot which produced small roots and (d) spring onion which showed slow growth and low yield

Transplanting multiple seedlings of spring onion in one hole resulted in slow plant growth and development, with consequent yield reduction. Multiple seedlings developed in tight clusters, with limited space between individual plants. When plants are too close together, they compete for light, nutrients, and root space, limiting the energy that can be allocated to bulb enlargement. Moreover, excessive leaf density shades the lower leaves, leading to leaf yellowing and reduced photosynthetic efficiency.

Key takeaway messages
Scout regularly and widely:

- Don't assume a pest only affects specific crops. Pests like African Bollworm can adapt to new hosts under changing climatic conditions.
- Inspect crops regularly from seedling to fruiting stage to detect signs of infestation early (e.g., holes in leaves or fruit, frass, or larvae).
- Introduce biological controls as part of an integrated pest management (IPM) approach.

Avoid over-seeding:

- Planting too many seeds per hole may seem like a way to increase germination chances in warm conditions, but it leads to overcrowding.
- Overcrowded crops like carrot, spinach, spring onion and beetroot suffer from

Transplanting multiple seedlings of spring onion in one hole resulted in slow plant growth and development, with consequent yield reduction

stunted growth, poor root or bulb development, and lower yield quality.
- Invest in good quality seed and pre-soak or prime them before planting to improve germination, which can reduce the urge to over-seed.

Don't skip timeous thinning:
- Thinning helps each plant develop to its full potential, improving uniformity, bulb size, and overall market value.

Despite these challenges, the trial provided practical, real-world lessons that will guide our future recommendations for vegetable production in arid regions. With climate change creating new pressures on agriculture, adaptability, research, and farmer knowledge-sharing are more important than ever.

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